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DRAFT

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16. Abstracts

This Environmental Impact Statement (EIS) was prepared in response to the proposed action of awarding grant funds to Guilford County, North Carolina for the purpose of developing a wastewater treatment system to service the Horsepen Creek area. The EIS consists of a description of the proposed action, the development and evaluation of alternatives, a description of the existing conditions in the area, the effects of the proposed action upon the area, and suggested measures to mitigative identified adverse impacts. The proposed action will replace an existing system of seven lift station and force mains with a new interceptor line and pump station designed to serve population without providing extensive capacity for growth.

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Horsepen Creek
Greensboro N.C.
pump station
interceptor line

17b. Identifiers/Open-Ended Terms

17c. COSATI Field/Group

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Environmental Protection
Agency

Region 4
345 Courtland Street, NE
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SEPTEMBER 1978

EPA

Environmental Impact Statement

Draft

Greensboro-Guilford County, North Carolina
Horsepen Creek Interceptor
EPA Project No. C37036901

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123

DRAFT ENVIRONMENTAL IMPACT STATEMENT

GREENSBORO-GUILFORD COUNTY, NORTH CAROLINA
HORSEPEN CREEK INTERCEPTOR
EPA PROJECT NO. C37036901

Prepared by
Environmental Protection Agency
Region IV
345 Courtland Street, N.E.
Atlanta, Georgia 30308

Approved

John C. White 8-25-78
Regional Administrator Date

In cooperation with
the State of North Carolina
Department of Natural Resources
and
Community Development
Raleigh, North Carolina 27611

Approved

9/13/78
Secretary Date

SUMMARY SHEET FOR ENVIRONMENTAL IMPACT STATEMENT

Greensboro-Guilford County, North Carolina
Horsepen Creek Interceptor
Project No. C-37036901

Draft (X)
Final ( )

Environmental Protection Agency
Region IV
345 Courtland Street
Atlanta, Georgia 30308

1. Type of Action: Administrative Action (X)
Legislative ( )

2. Brief Description of Proposed Action:

This Environmental Impact Statement was prepared in response to the proposed action of awarding grant funds to Guilford County, North Carolina for the purpose of developing a wastewater treatment system to service the Greensboro-Guilford County area of which the Horsepen Creek Interceptor is a part. The project consists of the necessary facilities to transport wastewater from the Horsepen Creek basin to the City of Greensboro wastewater collection system for treatment. All of the Horsepen Creek watershed and Lake Brandt, both of which are located entirely in Guilford County, North Carolina, will be potentially affected by the proposed action.

Physically, the proposed action consists of abandoning all lift stations in the Horsepen Creek basin except the Albert Pick lift station; construction of the Horsepen Creek interceptor and collectors running to the abandoned lift stations; construction of a new lift station and force main near U.S. Highway 220 to transfer Horsepen Creek interceptor wastewater to the North Buffalo Creek (NBC) collection system, and construction of a new force main from the Albert Pick lift station to transfer Deep River tributary wastewater to a new outfall discharging to the South Buffalo Creek (SBC) collection system. All lines are sized to serve the existing population in the Horsepen Creek basin, plus only limited additional capacity.

The proposed action will provide for:

(1) the elimination of the present system of lift stations and force mains in the area,

(2) a new collection system providing for transfer of existing wastewater flows in Horsepen Creek basin to the City of Greensboro wastewater collection system,

(3) allowance for controlled growth during urbanization of the Horsepen Creek basin, and

(4) sewering of areas with failing septic tanks.

3. Summary of Major Environmental Impacts

Direct adverse impacts associated with the proposed action are minor. Construction of the interceptor system will cause short-term, minor stream siltation and increased airborne particulates. Some natural vegetation will also be destroyed, continuing a trend to habitat fragmentation. Certain individuals will be subjected to temporary noise levels that exceed acceptable thresholds. Urbanization of the Horsepen Creek basin will probably be accelerated somewhat as a result of this project. Low density development with widespread septic tank use, as opposed to high density development with full sanitary sewerage, will be promoted. This will tend to minimize the deleterious effects of urban runoff on Horsepen Creek and ultimately on Lake Brandt. Likewise, the proposed action will necessitate that adequate growth management planning measures be adopted and current regulations be strictly enforced by local officials. This is necessary to ensure that contamination of the City of Greensboro's water supply in Lake Brandt does not occur as a result of expected growth in the Horsepen Creek watershed.

Significant adverse secondary impacts include an unavoidable lowering of water quality in Horsepen Creek due to urbanization. Land use changes accompanying increased urbanization will virtually eliminate farmland and forested areas in the basin, and reduced sediment loads to Horsepen Creek may promote eutrophication in Lake Brandt. Concentrations of pollutants in stormwater runoff, especially lead, will increase as urbanization of the basin occurs, which may result in unacceptably high levels of pollutants in Lake Brandt. Arsenic levels may increase as well if its concentration in Lake Brandt is dependent on pH of inflowing waters.

Major beneficial impacts include elimination of the present system of lift stations and force mains in the basin which have occasionally surcharged in the past. Many poorly designed or malfunctioning septic tank systems in current use will be eliminated. Finally, this project will promote the development of planning measures for orderly urban growth in the Horsepen Creek basin which are necessary to protect the City of Greensboro's water supply in Lake Brandt.

(2) a new collection system providing for transfer of existing wastewater flows in Horsepen Creek basin to the City of Greensboro wastewater collection system,

(3) allowance for controlled growth during urbanization of the Horsepen Creek basin, and

(4) sewering of areas with failing septic tanks.

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Major beneficial impacts include elimination of the present system of lift stations and force mains in the basin which have occasionally surcharged in the past. Many poorly designed or malfunctioning septic tank systems in current use will be eliminated. Finally, this project will promote the development of planning measures for orderly urban growth in the Horsepen Creek basin which are necessary to protect the City of Greensboro's water supply in Lake Brandt.

4. Summary of Alternatives Considered

The EIS process identified six (6) system alternatives for this project. These alternatives were subjected to a multilevel evaluation process (involving environmental, engineering, legal and cost constraints) and inputs from the Greensboro-Horsepen Creek EIS Advisory Committee. Alternatives 1 through 4 can be sized to serve either existing or future development.

Alternative 1 - abandon all lift stations in Horsepen Creek basin except Albert Pick lift station; construction of Horsepen Creek (HC) interceptor and collection lines to abandoned lift stations; construction of new lift station and force main near U.S. Highway 220 to transfer wastewater from HC interceptor to North Buffalo Creek (NBC) collection system.

Alternative 2 - abandon all lift stations in HC basin except Albert Pick lift station; construction of HC interceptor and collection lines to abandoned lift stations; construction of a new force main from Albert Pick lift station to new outfall discharging to South Buffalo Creek (SBC) collection system; construction of new lift station and force main near U.S. Highway 220 to transfer HC interceptor wastewater to NBC collection system.

Alternative 3 - abandon all lift stations in the HC basin except Stage Coach Trail, Wagon Wheel, and Albert Pick lift stations; Stage Coach Trail lift station will transfer wastewater to SBC collection system; construction of HC interceptor from Fleming Road-New Garden Road intersection to U.S. Highway 220 and collection lines to abandoned lift stations; construction of new lift station and force main near U.S. Highway 220 to transfer HC interceptor wastewater to NBC collection system.

Alternative 4 - abandon all lift stations in HC basin except Stage Coach Trail, Wagon Wheel, and Albert Pick lift stations; Stage Coach Trail lift station will transfer wastewater to SBC collection system; construction of new force main from Albert Pick lift station to new outfall discharging to SBC collection system; construction of HC interceptor from Fleming Road-New Garden Road intersection to U.S. Highway 220 and collection lines to abandoned lift stations; construction of new lift station and force main near U.S. Highway 220 to transfer HC interceptor wastewater to NBC Collection system.

Alternative 5 - No Action - maintain existing HC collection system; new wastewater sources in excess of capacity must be accommodated by septic tank systems.

Alternative 6 - Modified No Action - construction of new force main from Albert Pick lift station to new outfall discharging to SBC collection system; existing HC collection system will be maintained and operated with the addition of standby power.

5. Comments on the Draft Statement Have Been Requested from the Following:

Federal Agencies

Bureau of Outdoor Recreation
U.S. Coast Guard
Corps of Engineers
Council on Environmental Quality
Department of Commerce
Department of Health, Education and Welfare
Department of the Interior
Department of Transportation
Department of Housing and Urban Development
Economic Development Administration
Federal Highway Administration
Fisheries and Wildlife Service
Food and Drug Administration
Forest Service
Geological Survey
National Park Service
Soil Conservation Service
Department of Energy
Federal Power Commission

Members of Congress

Honorable Robert Morgan	U.S. Senate
Honorable Jesse A. Helms	U.S. Senate
Honorable Richardson Pryor	U.S. House of Representatives

State

James B. Hunt, Governor
Office of Intergovernmental Relations
Council of Governments
Division of Archives and History
Commission of Agriculture
Office of State Planning
North Carolina Wildlife Resources Commission

Local

Mayor, City of Greensboro, North Carolina
Chairman, Guilford County Commission
Chairman, Piedmont Triad Council of Governments

Interested Groups

Greensboro Chamber of Commerce
Board of Realtors

Interested Groups (Continued)

Greensboro Citizens Association
North Carolina A&T University
Environmental Action Coalition
League of Women Voters
Rural/Suburban Community
The Sierra Club
Guilford County Advisory Board for Environmental Quality
Concerned Citizens of McLeansville
McLeansville Community Council
Piedmont Council of Engineering and Technical Societies
NAACP
GATEWAYS
McLeansville Merchants Association
Greensboro Jaycees
Audubon Society
Homebuilders Association

6. Date Made Available to OFA and the Public

The Draft Statement was made available to OFA and the Public in October 1978.

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EXECUTIVE SUMMARY

This Environmental Impact Statement was prepared jointly by the State of North Carolina Department of Natural Resources and Community Development and the Environmental Protection Agency, Region IV, in response to legal requirements of the State of North Carolina and the United States. It addresses those areas stipulated by the National Environmental Policy Act of 1969, the North Carolina Environmental Policy Act of 1971, and the Council on Environmental Quality Guidelines of August, 1973.

1. Existing Environment

For the purposes of this Environmental Impact Statement (EIS), the study area includes all of the Horsepen Creek basin, as shown in Figure 1. The total environment is divided into natural and man-made aspects and each, while interactive, is discussed separately. Supporting documentation is provided in a Technical Reference Document (RA-R-507) and the Greensboro Draft EIS (EN-R-618).

a. Natural Environment

The Horsepen Creek basin area has a temperate climate with short, mild winters and long, hot summers. Precipitation is abundant.

Air pollutant emissions of the adjacent Greensboro area are typical of a moderately industrialized urban region. The general quality of the Greensboro area is good with respect to criteria pollutants. Guilford County has been designated an Air Quality Maintenance Area for suspended particulates.

Community-wide odor problems do not exist in the Horsepen Creek basin.

The noise climate of the study area is typical of similar suburban areas in the United States. Residential areas are characterized by low to moderate levels which, in most cases, do not intrude upon outdoor activities. Higher noise levels are present near major traffic arteries and the airport.

The topography of Guilford County is typical of the Piedmont Plateau physiographic province in that it is gently rolling in the uplands and somewhat more rugged near the major streams. The bedrock of the county consists of igneous and metamorphic rocks that are also typical of the Piedmont province. The bedrock is overlain by a thick mantle of saprolite (soft, weathered bedrock) in most of the county. The most important geologic processes are ground-water recharge and flooding.

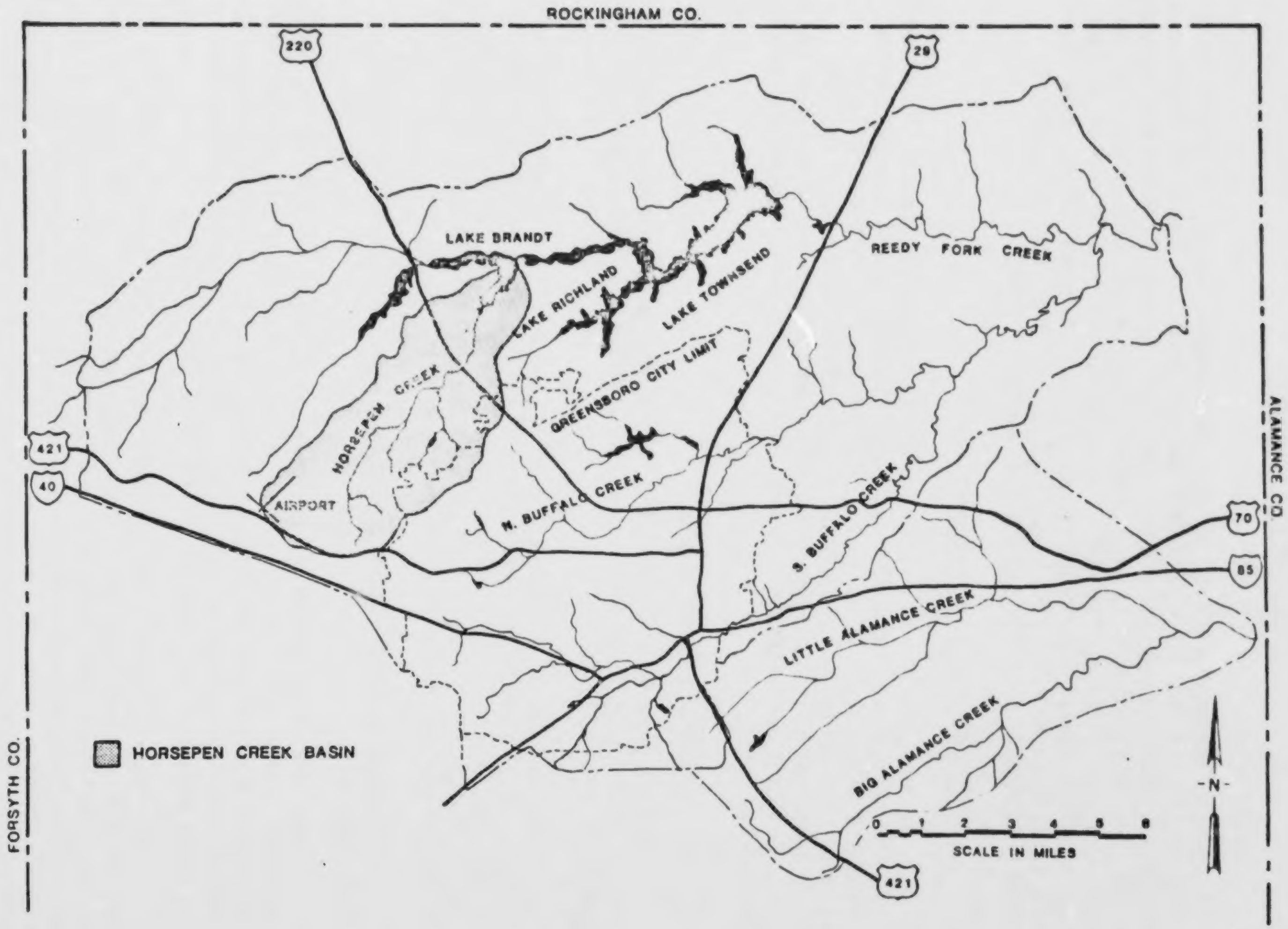

ROCKINGHAM CO.
ALAMANCE CO.
FORSYTH CO.
220
29
421
40
70
85
421
LAKE BRANDT
LAKE RICHLAND
LAKE TOWNSEND
REEDY FORK CREEK
HORSEPEN CREEK
GREENSBORO CITY LIMIT
AIRPORT
N. BUFFALO CREEK
S. BUFFALO CREEK
LITTLE ALAMANCE CREEK
BIG ALAMANCE CREEK
HORSEPEN CREEK BASIN
0 1 2 3 4 5 6
SCALE IN MILES
-N-

Figure 1. Location of Horsepen Creek Study Area

The soils of the Horsepen Creek basin are typical soils of the Piedmont uplands. Surface horizons are generally less than one foot in thickness and are composed of brown or sandy loam. Subsoils consist of red clay and are two to four feet in thickness. The soils are mostly developed on deeply weathered saprolite. Most of the Horsepen Creek soil series outside the floodplain areas have phases that are considered prime farmland soils. Nearly all of the soils in the study area are poorly suited to septic tank use, primarily because of low permeability in the subsoil horizon.

Horsepen Creek is the only stream in the study area. The 7-day, 10-year low flow is less than 2 cfs, and average flow is approximately 17 cfs. BOD levels are low and DO levels are high, indicating the current high water quality in Horsepen Creek. Some problems exist with high fecal coliform levels due to septic tank contamination. The stream is presently classified for drinking water use with a class A-II rating by the state of North Carolina. Horsepen Creek is a major water supply for Lake Brandt, a municipal water use reservoir for the city of Greensboro. Lake Brandt is considered moderately eutrophic. High turbidity which limits light penetration is probably responsible for preventing the growth of aquatic macrophytes or nuisance algal blooms, since adequate nutrient concentrations for excessive growth of aquatic flora are present in the lake. Preservation of Horsepen Creek water quality is widely perceived as a necessity in order to protect the Greensboro water supply in Lake Brandt.

Because of the geologic setting of Guilford County, major regional aquifers do not exist. However, shallow, low-productivity water-table aquifers are present and serve as important water sources in rural areas. The ground water of these aquifers occurs in pore spaces in the saprolite and in fractures in the underlying bedrock. Recharge to the aquifers occurs in the uplands, and discharge is to wells or as baseflow to the streams. The total ground water available in the county is estimated to be about 150 MGD, but only approximately 11 MGD is presently being used. Ground-water quality is generally good, except for a high iron content in some areas. Ground-water quality problems from septic tanks have been reported in the county.

The potential natural vegetation in the Horsepen Creek area is a climax hardwood forest. Man's use of the area has resulted in the establishment of a mixed oak-hickory-pine forest type which is now fragmented by cultivated fields, old fields, and urban areas. No virgin woodlands remain. About 38 percent of the total land in the study area is forested with second growth woodlands in various stages of succession.

Because man's use of the study area has fragmented the natural vegetation, forest species have decreased while species preferring disturbed habitats have increased. Small game animals and game birds have benefitted from fragmentation of the woodlands. Other game animals such as whitetail deer and wild turkey have been practically eliminated. Species tolerant of or especially adapted to man's alterations in natural conditions are generally characteristic of the area's fauna.

Sport fishing is restricted to Lake Brandt in the study area; habitat adequate for game fish in Horsepen Creek is probably restricted to a few small pools. However, benthic invertebrates are numerous and diverse in Horsepen Creek. The fresh water marsh located at the confluence of Horsepen Creek and Lake Brandt represents a unique habitat in the study area and is considered particularly sensitive to development.

No virgin woodland stands remain in the study area. Three plant species are listed as "threatened" throughout their range in North Carolina. The southern rain orchid (*Habenaria flava*), Nestronia (*Nestronia umbellula*), and ginseng are all moist lowland species. None of the mammals of Guilford County are considered endangered. The Bald Eagle once nested in the area and the Peregrine Falcone migrates through the region. Both are considered endangered by the U.S. Fish and Wildlife Service. The sharp-shinned hawk is considered threatened and is reported to nest near Lake Brandt. Species which are sensitive in the area because they are relictual populations or occur at the edge of their range include the white-crowned sparrow, crescent shiner, and an unidentified species of freshwater clam.

b. Man-Made Environment

The Horsepen Creek study area had 8,080 people in 1975 and is projected to have 18,700 in 2000. The land use pattern is a mixture of low-density suburban development along the eastern boundary, commercial and industrial in the southwestern portion, and agricultural and forest land along the western boundary.

The Greensboro area economy has grown since 1970 with 20,000 jobs created in Guilford County from 1970 to 1974. Unemployment has been low in recent years (normally under four percent). Manufacturing dominates the employment structure with textile employment being conspicuously important. Employment in manufacturing sectors such as wholesale/retail trade and services has grown in recent years.

Greensboro and Guilford County are providing police and fire protection, health care, education, waste disposal, libraries, and other public services that are essential. Greensboro and Guilford County are financially sound governments, paying for their needs with very little bonding required.

The Guilford County area has a rich cultural heritage which is being enhanced and protected. National Register historic sites are located in Greensboro and many buildings and areas of historic value have been identified. Also, the area may have archaeological resources, but they are not well known at this time. Recreational resources are scattered throughout the city and county.

As a focal point of North Carolina highways, Greensboro's major thoroughfares are heavily used. Thoroughfares are planned to relieve excess traffic loads as they develop, especially in peripheral areas.

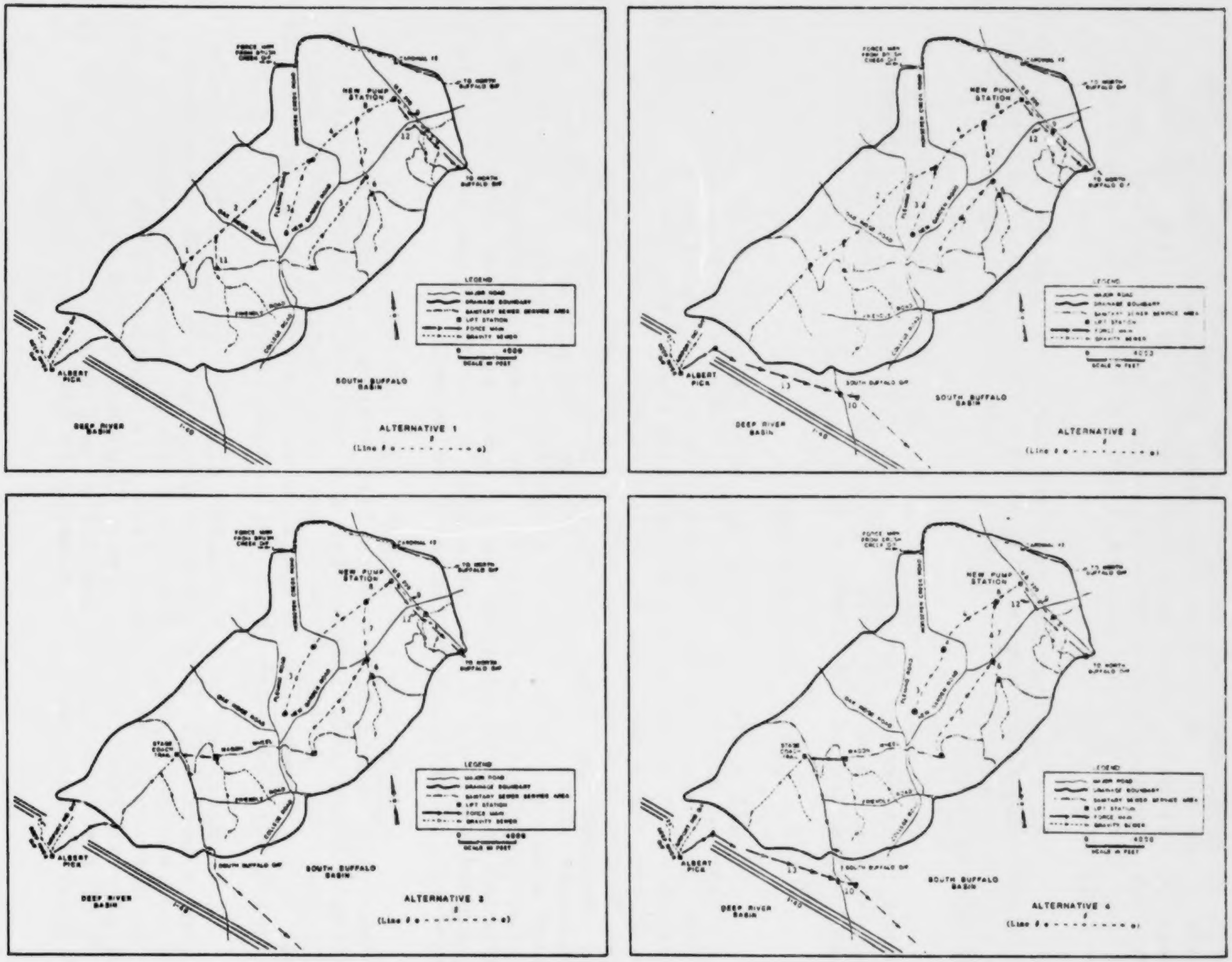
Duke Power Company will be able to meet the area's energy requirements through the year 2000 as long as coal and nuclear fuels are available. No major natural resources are being extracted in the study area.

2. System Alternatives

All system alternatives were developed with the assumption that an additional 10,620 people will move into the Horsepen Creek basin over the next 20 years providing sanitary sewerage is available. A total of six alternatives were considered, including No Action and a Modified No Action scheme. These alternatives were tested in a multilevel screening process involving environmental, engineering, legal and cost constraints, and inputs from the Greensboro-Horsepen Creek EIS Advisory Committee. A summary of these alternatives follows. Alternatives 1 through 4 are depicted graphically in Figure 2. The linework proposed for the Modified No Action Alternative is represented graphically in Alternatives 2 and 4. Alternatives 1 through 4 can be sized to serve either existing or future development.

Alternative 1 - abandon all lift stations in Horsepen Creek basin except Albert Pick lift station; construction of Horsepen Creek (HC) interceptor and collection lines to abandoned lift stations; construction of new lift station and force main near U. S. Highway 220 to transfer wastewater from HC interceptor to North Buffalo Creek (NBC) collection system.

Alternative 2 - abandon all lift stations in HC basin except Albert Pick lift station; construction of HC interceptor and collection lines to abandoned lift stations; construction of a new force main from Albert Pick lift station to new outfall discharging to South Buffalo Creek (SBC) collection system; construction of new lift station and force main near U. S. Highway 220 to transfer HC interceptor wastewater to NBC collection system.


FORCE MAIN FROM BRUSH CREEK O/F
NEW PUMP STATION
TO NORTH BUFFALO O/F
CARDINAL #5
ALBERT PICK
SOUTH BUFFALO BASIN
DEEP RIVER BASIN
I-40
LEGEND
MAJOR ROAD
DRAINAGE BOUNDARY
SANITARY SEWER SERVICE AREA
LIFT STATION
FORCE MAIN
GRAVITY SEWER
0
4000
SCALE IN FEET
ALTERNATIVE 1
ALTERNATIVE 2
ALTERNATIVE 3
ALTERNATIVE 4
(Line # o - - - - - - - - o)
STAGE COACH TRAIL
WAGON WHEEL
SOUTH BUFFALO O/F
1
2
3
4
5
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7
8
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10
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12
13

Figure 2. Horsepen Creek Wastewater Interceptor Alternative Numbers 1, 2, 3, & 4

Alternative 3 - abandon all lift stations in HC basin except Stage Coach Trail, Wagon Wheel, and Albert Pick lift station; Stage Coach Trail lift station will transfer wastewater to SBC collection system; construction of HC interceptor from Fleming Road-New Garden Road intersection to U. S. Highway 220 and collection lines to abandoned lift stations; construction of new lift station and force main near U.S. Highway 220 to transfer HC interceptor wastewater to NBC collection system.

Alternative 4 - abandon all lift stations in HC basin except Stage Coach Trail, Wagon Wheel, and Albert Pick lift stations; Stage Coach Trail lift station will transfer wastewater to SBC collection system; construction of new force main from Albert Pick lift station to new outfall discharging to SBC collection system; construction of HC interceptor from Fleming Road-New Garden Road intersection to U.S. Highway 220 and collection lines to abandoned lift stations; construction of new lift station and force main near U.S. Highway 220 to transfer HC interceptor wastewater to NBC collection system.

Alternative 5 - No Action - maintain existing HC collection system; new wastewater sources in excess of capacity must be accommodated by septic tank systems.

Alternative 6 - Modified No Action - construction of new force main from Albert Pick lift station to new outfall discharging to SBC collection system; existing HC collection system will be maintained and operated with the addition of standby power.

3. Description of the Proposed Action

The proposed action for wastewater collection system improvements in the Horsepen Creek basin is Alternative 2, which is sized for existing development plus very limited additional capacity and is composed of:

- abandonment of all lift stations except the Albert Pick in HC basin
- construction of HC interceptor along the creek and collection lines to abandoned lift stations to provide service to existing developed areas
- construction of a new force main from the Albert Pick lift station to transfer Deep River tributary wastewater to a new outfall discharging to the SBC collection system
- construction of a new lift station and force main near U.S. Highway 220 to transfer HC interceptor wastewater to the NBC wastewater collection system.

To ensure that certain safeguards are adopted, the disbursement of grant funds will be subject to the following conditions:

- Potentially affected areas will be surveyed to determine the presence of possible archaeological resources. This survey will be accomplished during the Step 2 process and the survey plan and results will be subject to approval by the North Carolina State Historic Preservation Officer and State Archaeologist.
- If possible and complying with good engineering practices, interceptor lines should be constructed completely out of or on the edges of the floodplain. This condition should be evaluated during Step 2.
- An erosion and sedimentation control plan must be submitted to DNRCD and EPA for approval of its acceptability.
- The maintenance of a 30-foot vegetative buffer between the edge of construction rights-of-way and stream banks will be required where feasible.
- The immediate revegetation of interceptor rights-of-way will be required.

4. Environmental Effects of the Proposed Action

a. Natural Environment

Direct air quality impacts of the proposed action will occur during the construction phase. Only total suspended particulates (TSP) are of any concern. A short-term increase in TSP levels from fugitive dust emissions may be expected to occur. Indirect impacts associated with the predicted urbanization of the Horsepen Creek area will be an elevation of ambient levels of all the criteria air pollutants.

No adverse odor impacts are expected as a result of the proposed action. A slight decrease in odor levels may occur due to elimination of several lift stations that occasionally surcharge.

Noise levels in the area will increase during the construction phase as a result of heavy equipment operation. Ambient noise levels will increase gradually due to urbanization and attendant increases in traffic, construction, etc.

No significant geological impacts are expected. Soil will be lost due to erosion during construction of the interceptor system. Urbanization of almost all prime farmland soils in area will be an indirect impact of this project. But this land use change is expected to reduce soil loss due to erosion.

Ground-water supplies should not be affected appreciably by this project. Total recharge in the area will be reduced slightly due to the increases in impervious area expected as a result of urbanization. Ground-water quality should not be adversely affected if good engineering practices are used to prevent exfiltration from the proposed sewer system, and the capacity of the lines is not exceeded. Existing septic tank problem areas will be provided with sewer service. The possiblity of future septic tank problems should be alleviated by strict enforcement of the new Guilford County septic tank ordinance.

The major direct impacts of the project on surface water quality will be improvements in quality due to the sewering of existing septic tank problem areas and the elimination of the system of lift stations. A short-term increase in sediment loads during construction is the major adverse direct impact. Indirect impacts are related to the predicted increase in non-point source pollution due to urbanization of the Horsepen Creek watershed. Ultimately, these impacts will be substantially less under the proposed action than they would be if the future service alternative were selected.

BOD, phosphorus, and heavy metals concentration are expected to increase in Horsepen Creek. Suspended solids and dissolved oxygen levels are expected to decrease. These changes in Horsepen Creek water quality will have an impact on Lake Brandt water quality as well. Reduced suspended solids levels will lower turbidity in the lake, and this, in turn, may promote eutrophication and the occurrence of nuisance algal blooms. Lead and arsenic levels may increase as a result of urbanization, presenting a serious problem to use of Lake Brandt water for drinking water purposes in Greensboro.

Direct impacts on the biological communities in the Horsepen Creek basin as a result of this project will be minor. Approximately 123 acres will be seriously disturbed during the construction phase. Indirect impacts will be more significant as urbanization occurs. The terrestrial habitats in the area will become more fragmented, favoring those plants and animals which are adapted to a closer association with man. The aquatic habitat in Horsepen Creek may be impaired if non-point source pollution increases. Any increase in pollutants will favor those aquatic organisms which are adapted to their presence. A decrease in aquatic biota diversity can be expected.

b. Man-Made Environment

Most of the land now presently under cultivation or forested will be converted to residential use under all project alternatives. The pattern of development should follow established trends with commercial and industrial development occurring primarily in the southwestern portion of the basin. Future subdivisions with sewers will probably occur adjacent to the already sewered areas. The necessity of a low density septic tank development in order to protect the Greensboro water supply in Lake Brandt will result in a more costly public services system. Under any alternative for the provision of sewer service almost all available land in the basin that is not environmentally sensitive will eventually be developed. Development of sensitive areas would have serious impacts, and should be restricted.

5. Mitigating Measures

General mitigating measures regarding the direct impacts of construction of an interceptor system on air quality, noise, soils, etc., are not discussed in this report. The interested reader is referred to the appropriate sections in the Greensboro EIS (EN-R-618) for this information. Mitigating measures concerning water quality and land use, those areas where significant adverse impacts can be expected to occur, are summarized in the following paragraphs.

Preservation of water quality in Horsepen Creek is largely the responsibility of the local governments in the area. As part of a program to preserve water quality, it is recommended that the appropriate governmental bodies initiate the following:

- development of a Section 208 planning program
- a regular water quality monitoring program for Horsepen Creek and Lake Brandt
- a comprehensive runoff control ordinance
- enforcement of the county subdivision ordinance restricting any development within the Horsepen Creek floodplain
- restriction of any development in the freshwater marsh at the confluence of Horsepen Creek and Lake Brandt
- legal restrictions preventing future tie-ins to the Horsepen Creek interceptor system beyond its design capacity

- strict enforcement of the Guilford County septic tank ordinance
- acquisition of lands for recreation and conservation

Minimizing adverse impacts related to land use will require Greensboro and Guilford County officials to plan for a particular growth scenario and implement controls to insure that development follows the plan. The Master Plan currently under consideration is a step in that direction. The "Open Space Program" of January, 1977, and the "Land Use Goals and Policies" statement of Guilford County demonstrate the desire of county officials for balancing development interests with environmental considerations.

In short, it appears that many of the control measures required to promote orderly land use and prevent development in environmentally sensitive areas are already in existence in some form or are under consideration. Strict enforcement of existing measures together with the institution of the additional measures proposed will provide a comprehensive program for water quality protection.

CHAPTER 1

INTRODUCTION

1.0 INTRODUCTION

All agencies of the federal government and the State of North Carolina are required by law* to prepare a detailed environmental impact statement (EIS) for major legislative and administrative actions significantly affecting the quality of the human environment. The objectives of implementing the EIS process are to (1) build into the decision-making process an appropriate and careful consideration of all environmental aspects of proposed actions, (2) explain potential environmental effects of proposed actions and their alternatives for public understanding, (3) avoid or minimize adverse effects of proposed actions, and (4) restore or enhance the quality of the environment as much as possible.

The North Carolina Department of Natural Resources and Community Development in concert with the Environmental Protection Agency determined that the issuance of federal and state funds for improvements to the Greensboro, North Carolina, wastewater treatment facilities constitutes a major action that potentially could significantly affect the quality of the human environment. Consequently, decisions were made to prepare a joint federal-state EIS, the Notice of Intent for which was released on April 5, 1976. Specific considerations of the environmental acceptability of the Horsepen Creek interceptor were included in this EIS. In investigating the secondary water-related effects of this interceptor, a rather lengthy monitoring study was required. Because (1) the Horsepen basin development was a separable issue from both historical and technological perspectives, and (2) it was in the interest of the total Greensboro 201 planning effort not to delay the post-Step 1 activities for the rest of the proposed facilities, EPA and the State subsequently decided in 1977 to prepare a separate EIS on the Horsepen Creek Interceptor. This report documents these NEPA activities related to Horsepen Creek. This EIS should be viewed as a companion to the Draft and Final EIS for the Greensboro-Guilford County 201 Wastewater Treatment System (EN-R-618, EN-R-687). These documents have been filed with the Council on Environmental Quality and the North Carolina Division of Environmental Management. They contain basic site- and activity-specific information that forms the basis for this EIS and are appended to this document by reference.

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*National Environmental Policy Act of 1969 (NEPA), 16 U.S.C. 4321 et seq., as implemented by Executive Order 11514 of March 5, 1970, the Council on Environmental Quality (CEQ) Guidelines of August 1, 1973; North Carolina Environmental Policy Act of 1971 (1971 C. 1203; 5.1), N.C. Gen. Stat. Ch: 113A (Cum. Supp. 1973).

Horsepen Creek is situated on the northwestern fringe of the Greensboro metropolitan area and lies along one of the paths of suburban growth of the city. Part of the basin is already developed, with wastewater services provided by a network of collectors, lift stations, and force mains and by residential septic tanks. Horsepen Creek and Reedy Fork to the north are impounded to form Lake Brandt, which is one of the city's water supplies. Water supplies are not abundant in the Greensboro area, due to its location in the headwaters of relatively small streams. As such, supplies will be strained to meet water demands by the end of this century. The water quality impacts of developing the Horsepen Creek watershed are a source of major concern among some interested parties, and in large measure have instigated this EIS.

Three generic types of structural alternatives are considered in this assessment: no action, service for currently existing population, and service for the projected future population. In addition, several physical configurations (i.e., routes and phasing) of the collector-interceptor system are possible, and a variety of non-structural measures related to institutional controls are considered. The proposed action constitutes the emplacement of an interceptor of restricted size designed to convey only the existing wastewaters that are generated within the basin. The total project capital cost for the selected alternative is $1.38 million, of which 75 percent will be provided by EPA and 12½ percent will be eligible for state funding. Annual operation and maintenance costs are only $8,500. The cost difference among the alternatives is very small, relative to the total cost of the Greensboro 201 facilities.

The preparation of this EIS has been guided by the proposed regulations of the Council on Environmental Quality for implementing NEPA (Federal Register, Volume 43, June 9, 1978). It is organized into chapters that summarize sequentially what the proposed action is, why it has been selected from available alternatives, what are the characteristics of the affected area, what are the environmental consequences, and what mitigative measures are available to lessen potential adverse impacts. The public participation program is described in the last chapter of this EIS.

CHAPTER 2

DESCRIPTION OF THE PROPOSED ACTION

2.0 DESCRIPTION OF THE PROPOSED ACTION

The proposed action for sewer system improvements to the Horsepen Creek service area includes abandoning all lift stations in the Horsepen Creek drainage basin and constructing an outfall interceptor from the Stage Coach Trail lift station along Horsepen Creek to U.S. Highway 220. A new force main will be constructed near Interstate 40 to transfer Deep River tributary wastewater from the existing Albert Pick lift station to the South Buffalo drainage basin and into a new outfall sewer which will discharge to the South Buffalo Creek collection system. New collectors will be constructed from the abandoned lift stations to the new Horsepen Creek interceptor to provide service to the existing developed areas. A new lift station and force main will be constructed near U.S. Highway 220 to transfer wastewater from the new Horsepen Creek interceptor to the North Buffalo Creek wastewater collection systems. All new facilities will be designed or sized to accommodate the existing wastewater flows However, minimum pipe sizes allowable for sewer construction as is used in this design will accommodate a service population of approximately 12,000 people. A schematic of the proposed collection and transfer wastewater system is shown in Figure 2-1. The exact number of people which could be served by the project will not be known until the Step 2 design is completed because of the effect of slope upon pipe capacity.

Facilities for the proposed action are designed to transfer approximately 1.3 MGD of domestic flow and approximately 1.1 MGD of industrial flow from the Horsepen Creek basin to the North and South Buffalo Creek basins, respectively, for treatment. Excluding the individual service laterals, the proposed facilities consist primarily of approximately 51,140 lineal feet of gravity sewer, 20,000 lineal feet of pressure mains, a 1.1 MGD lift station, and approximately 150 manholes.

Gravity sewers will be constructed of either vitrified clay pipe or PVC pipe and pressure mains will be constructed of either cast iron or concrete pipe. Manholes will be spaced approximately 400 feet apart along the gravity outfall.

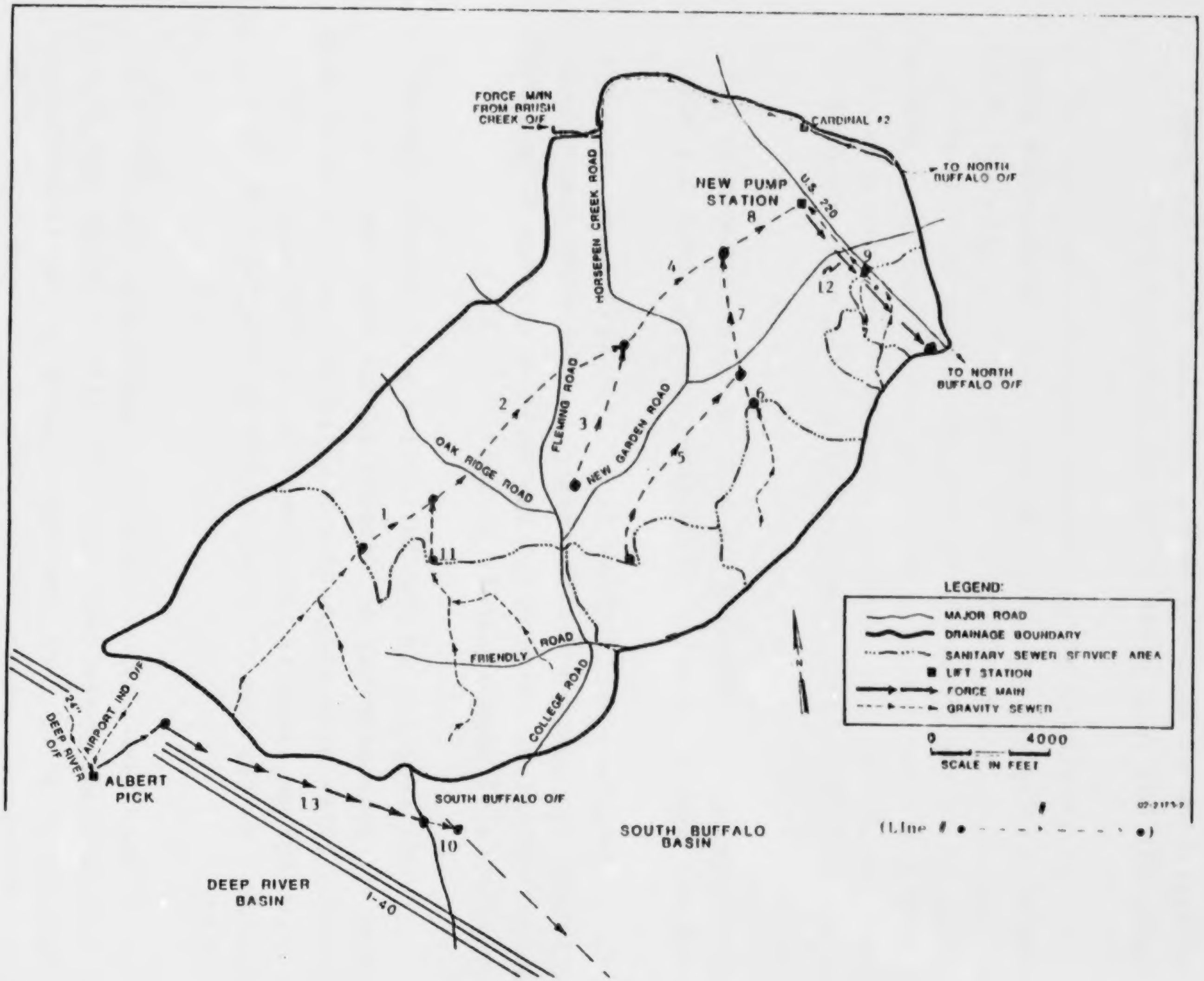
An inventory of the various transmission lines, as delineated in Figure 2-1, with design flows, recommended pipe sizes, and pipe lengths is shown in Table 2-1. Gravity sewers are designed on the basis of flowing two-thirds full at peak flow with a minimum velocity of 2 feet per second and a maximum velocity of 10 feet per second. Force mains are designed on the basis of flowing full at peak flow within the same velocity boundaries.

A new 50 horsepower lift station will be constructed near U.S. Highway 220 with a capacity to deliver approximately 1.1 MGD.

Construction of these facilities will occur over approximately two years and will result in temporary disturbance of about 330 acres. Excavation depths will average 5 feet with maximum depth of approximately 10 feet.

Construction of the facilities will require the employment of approximately 40 workers at any one time. Job responsibilities will range from skilled to unskilled positions and will include laborers, equipment operators, welders, and mechanics. No phasing of construction activities will be necessary.

Operation and maintenance requirements for the facilities will include operation of the two lift stations and periodic inspection, cleaning, and possible repairs of the transmission lines. Annual consumption of electricity for operation of the lift station will approximate 400 thousand kwhr.


FORCE MAIN FROM BRUSH CREEK O/F
HORSEPEN CREEK ROAD
CARDINAL #2
TO NORTH BUFFALO O/F
NEW PUMP STATION
8
U.S. 220
9
12
4
7
TO NORTH BUFFALO O/F
2
3
6
FLEMING ROAD
NEW GARDEN ROAD
OAK RIDGE ROAD
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11
FRIENDLY ROAD
COLLEGE ROAD
AIRPORT IND O/F
24"
DEEP RIVER O/F
ALBERT PICK
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SOUTH BUFFALO O/F
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SOUTH BUFFALO BASIN
DEEP RIVER BASIN
I-40
LEGEND:
MAJOR ROAD
DRAINAGE BOUNDARY
SANITARY SEWER SERVICE AREA
LIFT STATION
FORCE MAIN
GRAVITY SEWER
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Figure 2-1. Alternative 2

TABLE 2-1
DESCRIPTION OF HORSEPEN CREEK WASTEWATER TRANSMISSION LINES

Line No.	Designation	Design Flow (CFS)	Diameter (inches)	Length (feet)	No. of Manholes
1	Gravity	0.204	8	3800	10
2	Gravity	0.612	10	10800	27
3	Gravity	0.101	8	5000	13
4	Gravity	0.714	10	5800	15
5	Gravity	0.371	8	8800	22
6	Gravity	0.371	8	840	21
7	Gravity	0.301	10	4800	12
8	Gravity	1.112	12	4400	11
9	Gravity	0.309	8	5000	13
10	Gravity	1.422	10	1000	3
11	Gravity	0.408	8	900	3
12	Force Main		8	8600	
13	Force Main		14	12000	

To ensure that certain safeguards are adopted, the disbursement of grant funds will be subject to the following conditions:

(1) Potentially affected areas will be surveyed to determine the presence of possible archaeological resources. This survey will be accomplished during the Step 2 process. The survey plan and results will be subject to approval by the North Carolina State Historic Preservation Officer and State Archaeologist.

(2) If possible and complying with good engineering practices, interceptor lines should be constructed completely out of or on the edges of the floodplain. This condition should be evaluated during Step 2.

(3) An erosion and sedimentation control plan must be submitted to the Division of Natural Resources and Community Development and EPA for approval of its acceptability.

(4) The maintenance of a 30-foot vegetative buffer between the edge of construction rights-of-way and stream banks will be required where feasible.

(5) The immediate revegetation of interceptor rights-of-way will be required.

Additional measures proposed to be taken at the local level to mitigate adverse impacts of population growth upon water quality are presented in Chapter 6.

CHAPTER 3

ALTERNATIVES

3.0 ALTERNATIVES

3.1 Description of Alternatives Considered

The agencies have developed five engineering alternatives for providing sewer service to the existing and/or future populations of the Horsepen Creek drainage basin. A "No Action" alternative is included as one of these alternatives. The alternatives were not intended to include every sewer line that may be conceivably required. Rather, only the primary collectors, lift stations, force mains, and interceptor necessary to service the existing and expected future development were considered. The alternatives to be evaluated are described below.

3.1.1 Configuration

Four alternative configurations, all of which can service either existing or future development, plus the "No Action" alternative for existing development, have been selected as possible configurations for the Horsepen Creek interceptor system.

3.1.1.1 Alternative 1

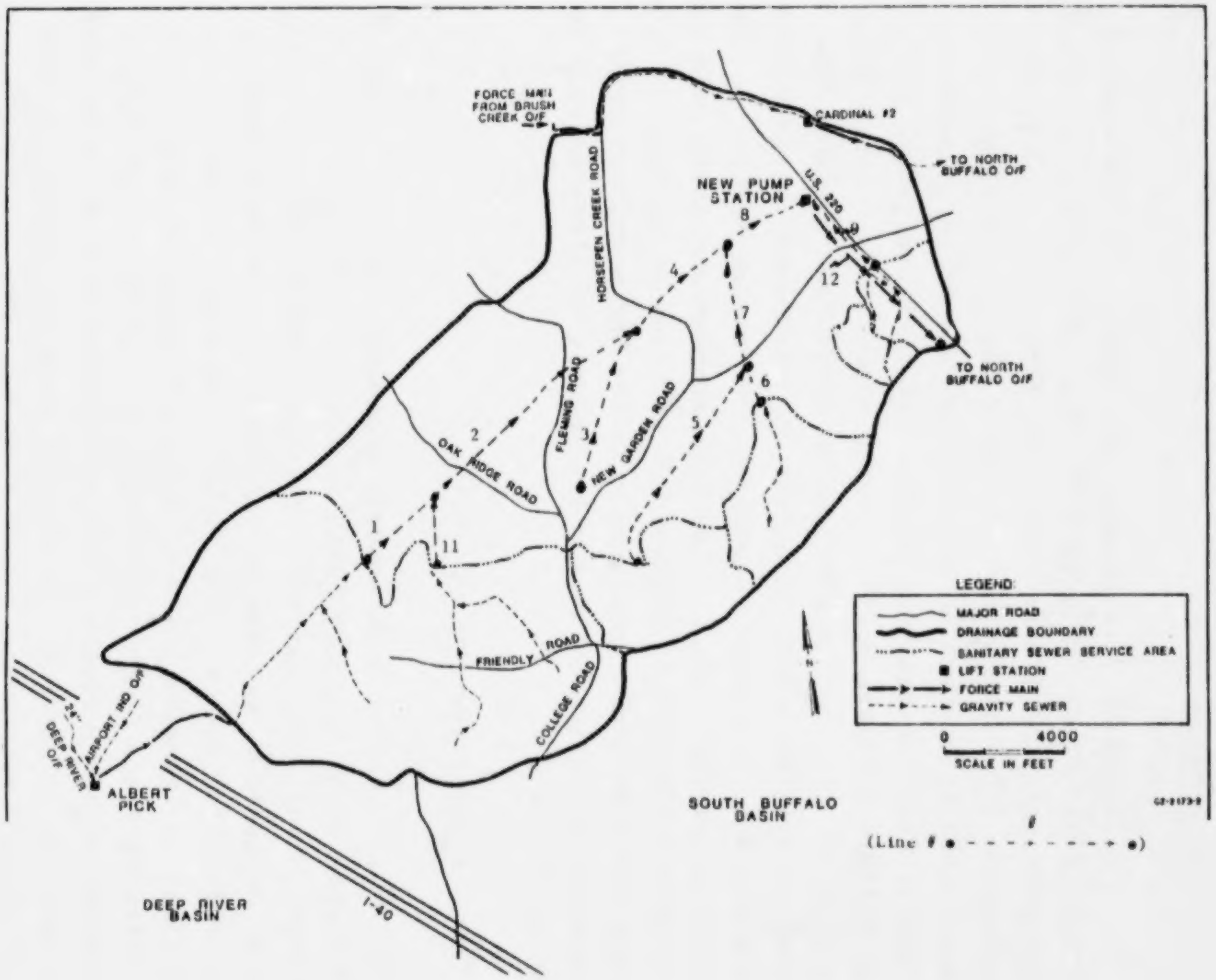
Alternative 1 recommends abandoning all lift stations in the Horsepen Creek drainage basin and constructing an outfall interceptor from the Stage Coach Trail lift station along Horsepen Creek to U.S. Highway 220. The Albert Pick lift station will be maintained to transfer the Deep River tributary wastewater to the Horsepen Creek collection system. New collectors will be constructed from the abandoned lift stations to the new Horsepen Creek interceptor to provide service to the existing developed areas. A new lift station and force main will be constructed near U.S. Highway 220 to transfer wastewater from the new Horsepen Creek interceptor to the North Buffalo Creek wastewater collection system. A schematic of Alternative 1 is shown in Figure 3-1.

3.1.1.2 Alternative 2

Alternative 2 recommends abandoning all lift stations in the Horsepen Creek drainage basin and constructing an outfall interceptor from the Stage Coach Trail lift station along Horsepen Creek to U.S. Highway 220. A new force main will be constructed near Interstate 40 to transfer Deep River tributary wastewater from the existing Albert Pick lift station to the South Buffalo drainage basin and into a new outfall sewer which discharges to the South Buffalo Creek collection system. New collectors will be constructed from the abandoned lift stations to the new Horsepen Creek interceptor to provide service to the existing developed areas. A new lift station and force main will be constructed near U.S. Highway 220 to transfer wastewater from the new Horsepen Creek interceptor to the North Buffalo Creek wastewater collection systems. A schematic of Alternative 2 is shown in Figure 3-2.

3.1.1.3 Alternative 3

Alternative 3 recommends abandoning all lift stations in Horsepen Creek drainage basin except the Stage Coach Trail and Wagon Wheel lift stations. The Stage Coach Trail lift station will be maintained to transfer wastewater to the South Buffalo Creek collection system. The Albert Pick lift station will be maintained to transfer the Deep River tributary wastewater to the existing Stage Coach Trail collection system as currently practiced. A new Horsepen Creek interceptor will be constructed from near the intersection of Fleming Road and New Garden Road to and along Horsepen Creek to U.S. Highway 220. New collectors will be constructed from the abandoned lift station to the new Horsepen Creek interceptor to provide service to the existing


FORCE MAIN FROM BRUSH CREEK O/F
CARDINAL #2
TO NORTH BUFFALO O/F
NEW PUMP STATION
U.S. 220
HORSEPEN CREEK ROAD
FLEMING ROAD
NEW GARDEN ROAD
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FRIENDLY ROAD
COLLEGE ROAD
TO NORTH BUFFALO O/F
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DEEP RIVER O/F
AIRPORT IND O/F
ALBERT PICK
DEEP RIVER BASIN
I-40
SOUTH BUFFALO BASIN
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LEGEND:
MAJOR ROAD
DRAINAGE BOUNDARY
SANITARY SEWER SERVICE AREA
LIFT STATION
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GRAVITY SEWER
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Figure 3.1. Alternative 1

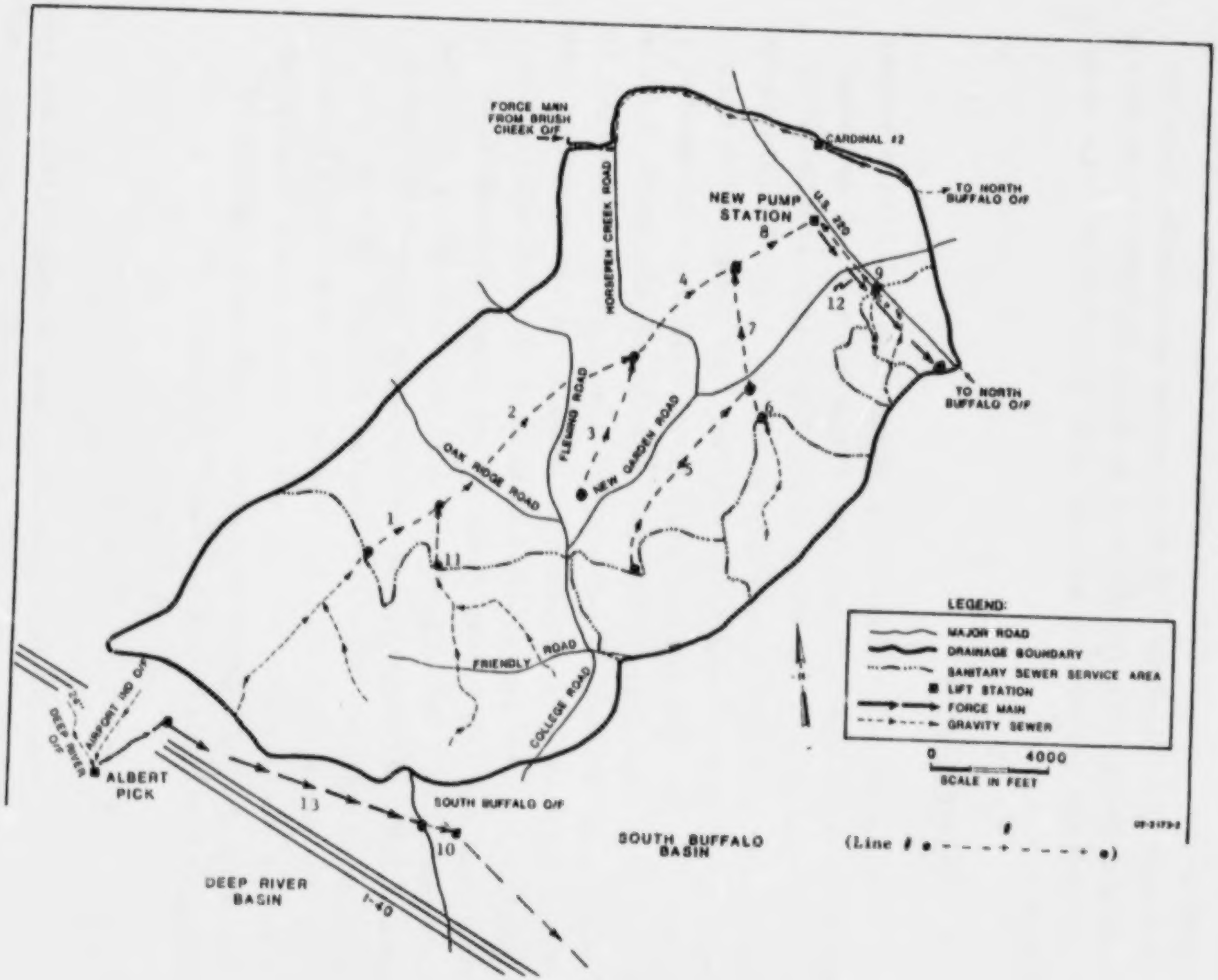
FORCE MAIN FROM BRUSH CREEK O/F
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Figure 3-2. Alternative 2

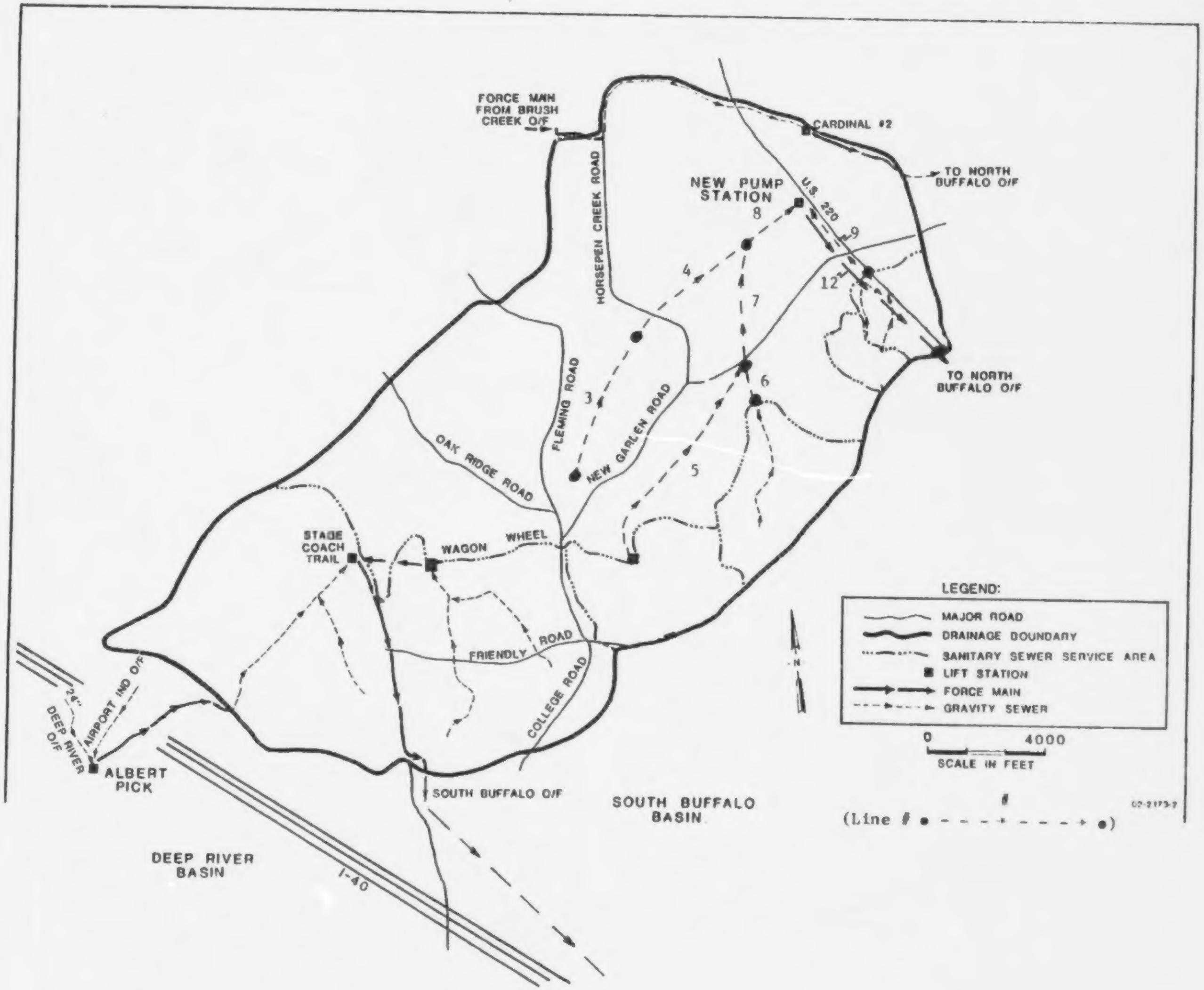
Horsepen Creek interceptor to provide service to the existing developed areas. A new lift station and force main will be constructed near U.S. Highway 220 to transfer wastewater from the new Horsepen Creek interceptor to the North Buffalo Creek wastewater collection system. A schematic of Alternative 3 is shown in Figure 3-3.

3.1.1.4 Alternative 4

Alternative 4 recommends abandoning all lift stations in Horsepen Creek basin except the Stage Coach Trail and Wagon Wheel lift stations. The Stage Coach Trail lift station will be maintained to transfer wastewater to the South Buffalo Creek collection system. A new force main will be constructed near Interstate 40 to transfer the Deep River tributary wastewater from the existing Albert Pick lift station to the South Buffalo drainage basin and into a new outfall sewer which discharges to the South Buffalo Creek collection system. A new Horsepen Creek interceptor will be constructed from near the intersection of Fleming Road and New Garden Road to and along Horsepen Creek to U.S. Highway 220. New collectors will be constructed from the abandoned lift stations to the new Horsepen Creek interceptor to provide service to existing developed areas. A new lift station and force main will be constructed near U.S. Highway 220 to transfer wastewater from the new Horsepen Creek interceptor to the North Buffalo Creek wastewater collection system. A schematic of Alternative 4 is shown in Figure 3-4.

3.1.1.5 Alternative 5 - No Action

The existing Horsepen Creek wastewater collection system will be maintained and operated as currently practiced. Any new wastewater sources in excess of the capacity of the existing facilities must be accommodated by septic tank systems. A schematic of the existing facilities is shown in Figure 3-5.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TO NORTH BUFFALO O/F
NEW PUMP STATION
U.S. 220
HORSEPEN CREEK ROAD
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NEW GARDEN ROAD
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STAGE COACH TRAIL
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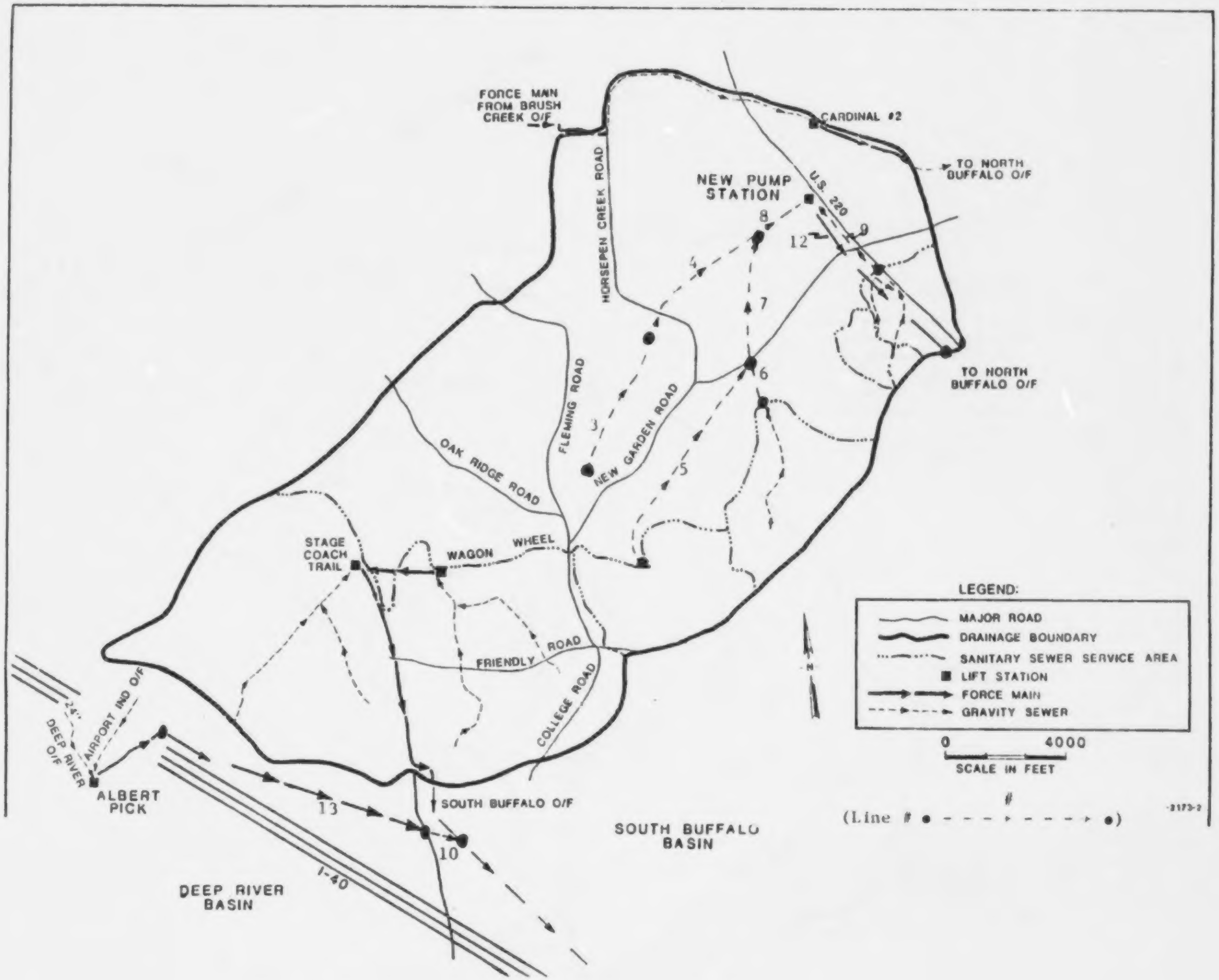
Figure 3-3. Alternative 3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NEW PUMP STATION
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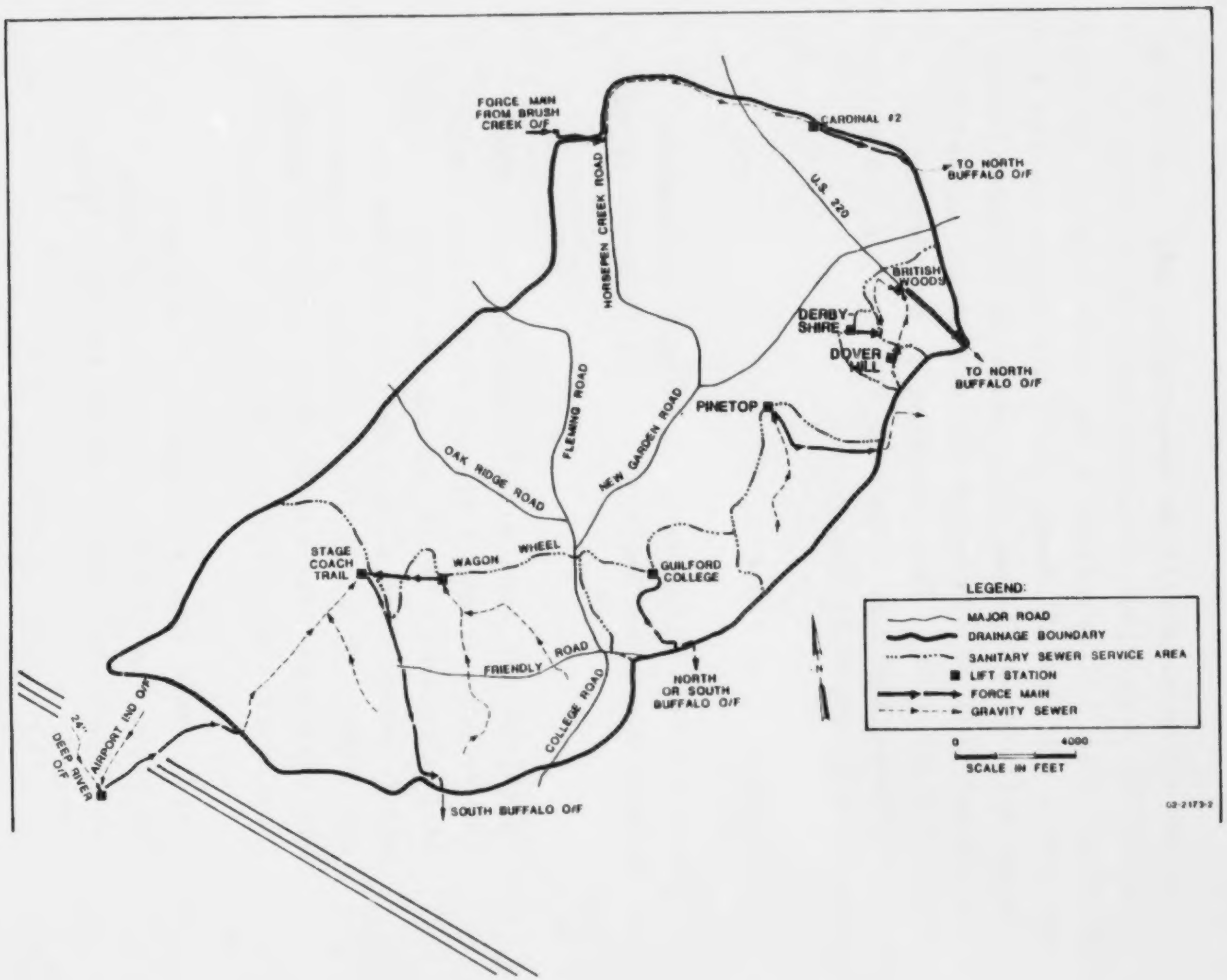
Figure 3-4. Alternative 4


FORCE MAIN FROM BRUSH CREEK O/F
CARDINAL #2
TO NORTH BUFFALO O/F
U.S. 220
HORSEPEN CREEK ROAD
BRITISH WOODS
DERBY-SHIRE
DOVER HILL
TO NORTH BUFFALO O/F
PINETOP
FLEMING ROAD
NEW GARDEN ROAD
OAK RIDGE ROAD
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WAGON WHEEL
GUILFORD COLLEGE
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Figure 3-5. Existing Facilities (No Action Alternative)

3.1.1.6 Alternative 6 - Modified No Action

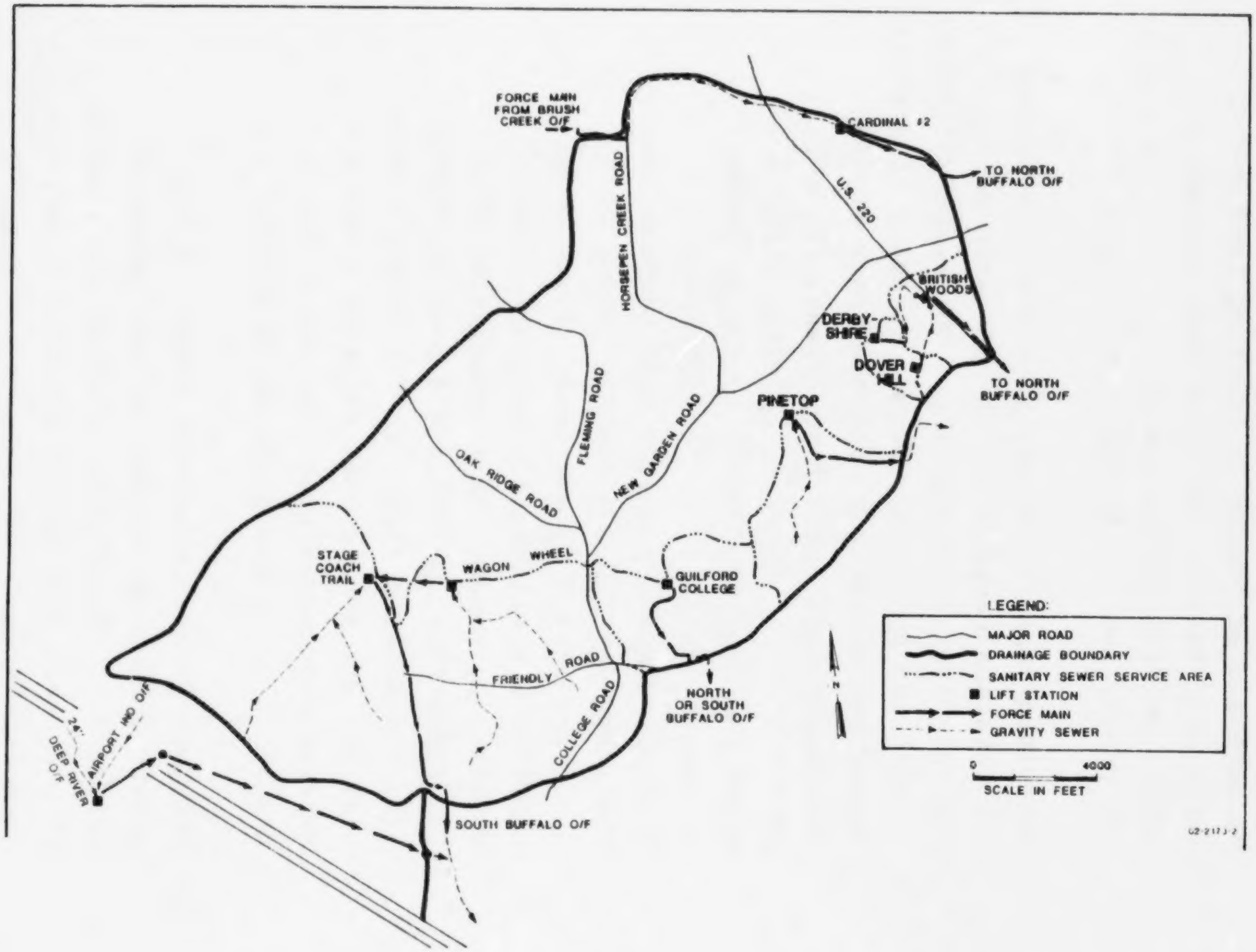
A new force main will be constructed near Interstate 40 to transfer the Deep River tributary wastewater from the existing Albert Pick lift station to the South Buffalo drainage basin and into a new outfall sewer which discharges to the South Buffalo Creek collection system. The existing Horsepen Creek collection system will be otherwise maintained and operated in its current configuration. This alternative was developed through the Citizens Advisory Committee Process. A schematic of Alternative 6 is shown in Figure 3-6.

3.1.2 Collection Line Sizes

The collection lines were sized by a systematic, consistent methodology. The basic procedure followed is outlined below.

(1) Calculate per capita flow contribution. The future population of the Horsepen Creek basin is projected to be 18,700 persons with an estimated sewage flow of 1.3 million gallons per day (MGD). Thus, 18,700/1,300,000 = 70 gallons per capita per day was assumed to be the average flow contribution for residents in the basin.

(2) Divide basin into subbasin service areas. The basin was divided into seven subbasins (see Figure 3-6) according to existing sewer service.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CARDINAL #2
TO NORTH BUFFALO O/F
U.S. 220
HORSEPEN CREEK ROAD
BRITISH WOODS
DERBY-SHIRE
DOVER HILL
TO NORTH BUFFALO O/F
PINETOP
FLEMING ROAD
NEW GARDEN ROAD
OAK RIDGE ROAD
STAGE COACH TRAIL
WAGON WHEEL
GUILFORD COLLEGE
FRIENDLY ROAD
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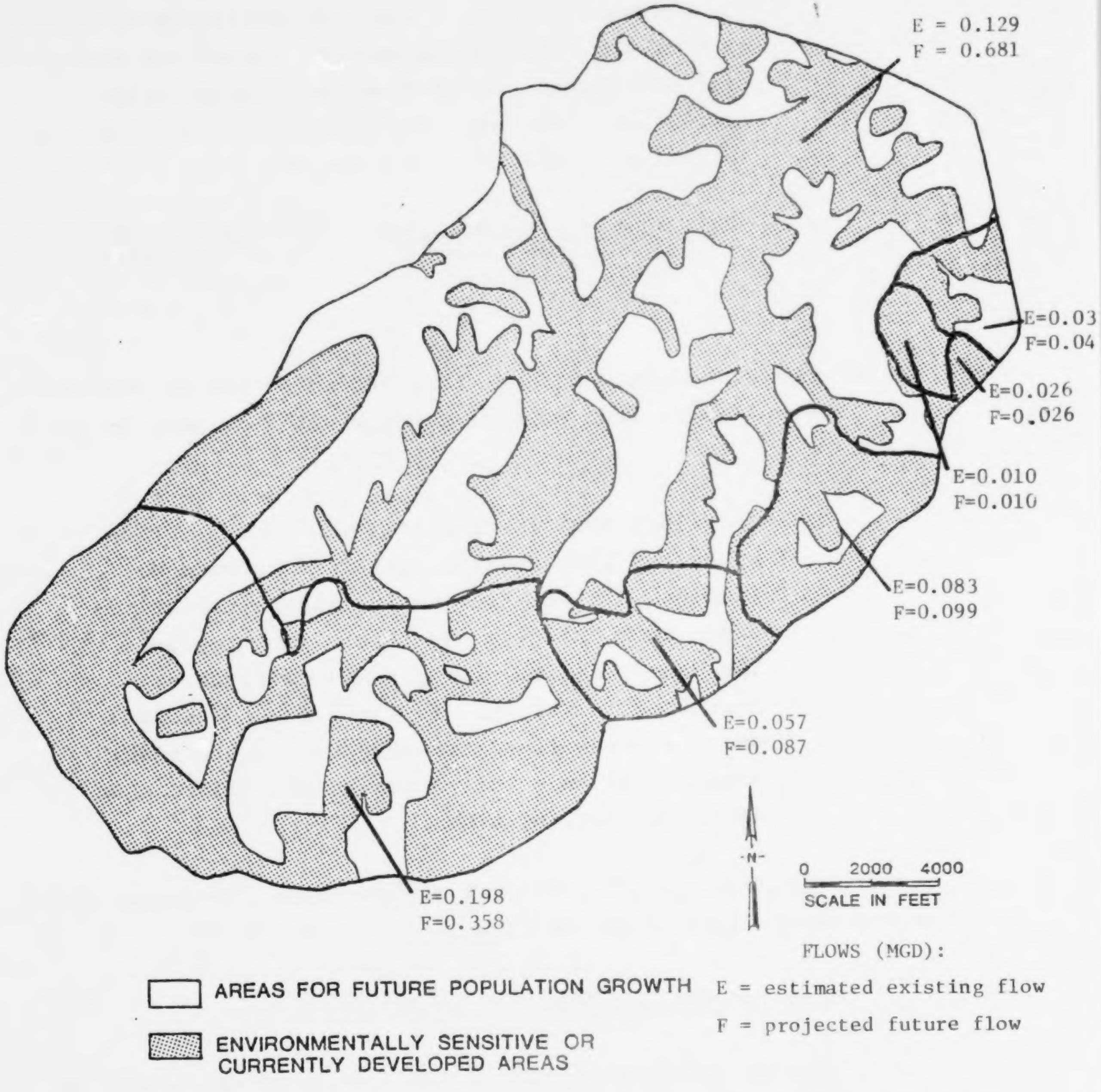
Figure 3-6. Alternative 6 (Modified No Action)

(3) Disaggregate existing population. The existing population of 8,080 persons was disaggregated by subbasin according to existing land use patterns. Residential areas were assumed to have a uniform population density, and the existing population was divided accordingly.

(4) Calculate capacity of existing sewerage system. All existing sewer lines in the basin were evaluated for flow capacity. The Hazen-Williams formula was employed. Design capacity of gravity sewers was calculated with the lines flowing two-thirds full. The formula was: $Q_D = 1.32 CR^{0.63} S^{0.54} A$, where Q_D = design flow; S = slope (determined from 7½' U.S.G.S. quads): at two-thirds full, $A = 0.5594D^2$ and $R = 0.2914D$, where D = inside pipe diameter in feet; and C = 100. A peaking factor of 2 x average flow = Q_D was used. Force main capacity was calculated using the Hazen-Williams alignment chart (nomograph) with the pipes flowing full and a peaking factor of 2.4 x average flow. The results of these calculations showed that existing lines are extremely over-designed, and all lines in the basin are running far below capacity.

(6) Estimate future wastewater flows. Future growth will occur in the unshaded areas of Figure 3-7. These areas exclude those parts of the basin that cannot (or should not) accommodate growth. The non-growth areas include current residential areas (both sewered and non-sewered), industrial areas, and environmentally sensitive areas (see Figure II-21 of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F = 0.681
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F=0.04
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E=0.083
F=0.099
E=0.057
F=0.087
E=0.198
F=0.358
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SCALE IN FEET
FLOWS (MGD):
E = estimated existing flow
F = projected future flow
AREAS FOR FUTURE POPULATION GROWTH
ENVIRONMENTALLY SENSITIVE OR CURRENTLY DEVELOPED AREAS

Figure 3-7. Future Growth Areas in the Horsepen Creek and Wastewater Flows by Subbasin

the Greensboro DEIS). The area available in each of the seven subbasins for future residential development was derived by planimetering. Population increases were allocated proportionately according to the following formula:

$$\frac{\text{Population Increase in Subbasin}}{\text{Total Projected Population Increase (=10,620)}} = \frac{\text{Subbasin Areas (acres)}}{\text{Total Area Available for Future Growth (=3,107 acres)}}$$

This, of course, assumes uniform distribution of future population. Flow estimates from each of these areas were made as in Step 4.

(7) Calculate additional facilities' needs. Pipe sizes and lift station requirements were determined for all four engineering alternatives under both existing and future flow regimes. The Hazen-Williams formula was employed as described in Step 5. In the largest subbasin, where several lines traverse the future growth areas, flow from that subbasin was apportioned among the various lines.

The results of this analysis produced the design sizes for the sewer lines segments shown in Table 3-1

3.2 Environmental Evaluation of Alternatives

Agency guidelines require that the proposed action be the cost-effective option selected from a group of environmentally acceptable alternatives. To the extent practicable, the cost-effective analysis should maximize environmental benefits while

TABLE 3-1

DESIGN SIZES FOR SEWER LINE SEGMENTS (Diameter in inches)

	Alternative #										Line Length (feet)
Line #	1E	1F	2E	2F	3E	3F	4E	4F	5	6	
1	14	14*	8	8	-	-	-	-	-	-	3,800
2	20	22*	10	14	-	-	-	-	-	-	10,800
3	8	8	8	8	8	8	8	8	-	-	5,000
4	20	24*	10	16	8	10	8	10	-	-	5,800
5	8	8	8	8	8	8	8	8	-	-	8,800
6	8	8	8	8	8	8	8	8	-	-	840
7	10	12	10	12	10	12	10	12	-	-	4,800
8	20	26*	12	20	10	16	10	16	-	-	4,400
9	8	8	8	8	8	8	8	8	-	-	5,000
10	-	-	10	10	-	-	10	10	-	10	1,000
11	8	10	8	10	-	-	-	-	-	-	900
12	12	14*	8	12	8	10	8	10	-	-	8,600
13	-	-	14	14	-	-	14	14	-	14	12,000

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*Estimates based on ratio of 2E:2F

minimizing costs and environmental detriments. At the minimum, however, the cost-effective option must not possess over-riding environmental problems. It is within this context that the analysis of alternatives for the Horsepen Interceptor has been conducted. The ultimate goal of this analysis is primarily to distinguish environmentally acceptable options (i.e., those free of over-riding adverse impacts), and secondarily to suggest the degree of their environmental acceptability.

The alternatives analysis is couched in terms of quantitative and qualitative effects on the air, land, water, biological, and cultural resources of the Horsepen Creek vicinity. Besides the No-Action alternative, the alternatives may be categorized as to whether they serve only the "Existing" conditions (Alternatives 1E, 2E, 3E, and 4E) or the projected "Future" development (Alternatives 1F, 2F, 3F, and 4F). It should also be recognized that all new alternative configurations of the sewerage system have a large common component, i.e., the lower portion of the basin (approximately, downstream of New Garden Road).

3.2.1 Air Quality

None of the area is currently a non-attainment area for any criteria pollutants. Nevertheless, the differences in air quality impact associated with the various alternatives must be addressed on a pollutant-specific basis. Further, at the level of analysis available for this study, air quality considerations revolve around the three generic types of alternatives (Existing, Future, and No Action), rather than the configurations of the sewerage alternatives.

On the basis of monitoring data and national-level considerations, secondary impacts to air quality appear of more concern than short-term primary effects related to construction. Specifically, total suspended particulates and photochemical oxidant precursors, such as hydrocarbons and nitrogen oxides, are recognized generally as sensitive to population growth.

The area quality maintenance analysis performed for the Greensboro AQMA demonstrated that population density is a good indicator of TSP levels. This study encompassed too large an area to be useful for specifically analyzing differences in alternatives for the Horsepen Creek interceptor. But generally, an alternative that results in higher population density will be more adverse with respect to TSP. Hence, any "Future"-type alternative will increase TSP levels in the area more than "Existing" types or "No Action". While recent trends are encouraging, TSP levels that have been monitored at representative locations are already high, and provisions of Prevention of Significant Air Quality Deterioration with respect to TSP conceivably could be limiting to industrial growth in some areas. It should be recognized that a trade-off exists: particulate emissions from agricultural and other rural activities will be replaced by urban particulate emissions. Urban-area particulates are largely man-made and tend to be more hazardous to human health and welfare than those from natural origins.

Growth in the Horsepen Creek basin and the rest of Guilford County may also cause increases in photochemical oxidant levels. Since this pollutant is not currently monitored, this is an unknown problem. But EPA has acknowledged the validity of studies showing that any urban area over 200,000 population should be a candidate for oxidant precursor emissions reductions. Such reductions may ultimately be required to prevent local and regional oxidant problems. However, the effects of oxidants are apparently not sensitive to the exact geographical distribution of the population. Therefore, all alternatives would have essentially the same impact with respect to oxidant levels.

The air quality impacts of population growth due to wastewater facility expansions must be analyzed pursuant to Section 316 of the 1977 Clean Air Act Amendments. Revisions to state implementation plans are to include consideration of these impacts. At this time it is unclear if and how these revisions would affect the analysis of the available alternatives, since no regulations implementing the Amendments have been promulgated. It should be remembered, however, that growth in Horsepen Creek is only part of the projected growth for the Greensboro area, so the incremental air quality impact really cannot be avoided, only minimized by the type of development encouraged.

Odor is also a gaseous air-borne pollutant. Those alternatives that provide transmission of Deep River tributary wastewater directly to the South Buffalo basin (2E, 2F, 4E, 4F, and 6) will likely have very slow moving wastewater in the upper portion of Horsepen basin because of the grossly oversized existing sewer lines there. This condition, which will be extreme during dry weather flows under alternatives 2E, 4E, and 6, may result in periodic odors of septic sewage from manholes and wet wells, unless the lines are regularly flushed out. The efficacy of this may be limited by the capacity of the downstream lift station to convey the water to the South Buffalo plant for treatment. In aggregate, this mitigating measure is a substantial waste of valuable water and energy resources.

3.2.2 Land Resources

The major limitation to development is the poor septic tank suitability of the soils in the basin. This will make proper site evaluation, drainfield design, and maintenance practices more critical than soil series (types) in determining septic tank feasibility. Generally, however, the upland soil series on the margin of the basin and the soils throughout the lower basin are expected to perform somewhat better than the soils elsewhere in the basin (see Figure 4-3). The primary impact of malfunctioning septic tanks would probably be surface-water quality degradation, as opposed to ground water effects, due to the rather large thickness of impermeable rock material in this area, and due to the impermeable subsoils that would tend to conduct poorly renovated effluent laterally.

The central (non-upland) part of the upper basin includes large areas underlain by fairly erodible soil. Some alternatives (1E, 1F, 2E, 2F) have considerably more rights-of-way that cross these erodible areas and that are near streams than other alternatives. (All of these four alternatives require constructing an interceptor along virtually the entire length of Horsepen Creek). These considerations suggest that degradation of aquatic habitat, currently of high quality, can readily occur unless sediment control is diligently practiced. While substantial amounts of chiefly non-settleable (colloidal) solids are currently delivered to streams, construction may promote delivery of large quantities of settleable solids. Stream siltation and the substrate instability may produce undesirable consequences on the aquatic flora and fauna of Horsepen Creek and Lake Brandt.

A cumulative impact of all alternatives will be the urbanization of prime farmland soils. Most of the acreage in the Horsepen basin is in the Cecil, Mecklenburg, Madison, and Enon soil series, all of which have phases that are considered prime farmland soils. Most agriculture presently exists in the southwestern portion of the basin. A substantial portion of the basin underlain by prime farmland soils is now forest, and will probably never become farmland, inasmuch as its economic value for suburban development now far exceeds its agricultural potential. Unless outright prohibition on development occurs, ultimately (beyond the design period) the entire basin will urbanize, whether on sewers, septic tanks, small lift stations, or a mixture of the three. From this ultimate perspective, no differences exist among the alternatives. Providing efficient sewerage probably only hastens the ultimate condition.

3.2.3 Water Resources

The Horsepen basin has an under-developed ground-water supply. High-quality ground water is readily available to individual users throughout the basin. Individual domestic users (or groups of users) will be able to exploit the ground-water resources and ease regional water-supply problems that are just now becoming apparent. Despite the poor permeability of the soils and the large thickness of saprolite, the concomitant use of ground water within the fractured-rock aquifer and of septic tanks for wastewater treatment would be a source of concern. The integrity of the ground-water supply in a local area could not be guaranteed in such a hydrogeologic setting with septic tank use.

As the Horsepen Creek basin drains to Lake Brandt, the effects of existing and future development in the basin are a source of concern. It is widely recognized that urbanization will generally tend to promote increased runoff with substantially impaired quality. For this reason, a special study of this problem was undertaken as part of the decision-making effort. The study report is entitled "Investigation of Water Quality Impacts Related to Development of the Horsepen Creek Basin, Guilford County, North Carolina" (RA-R-507). The reader is referred to this report for details concerning scope, methodologies, and results. The study concluded that if an interceptor is constructed to serve the projected future population, subsequent intensive development within the basin would significantly degrade the water quality of Horsepen Creek and Lake Brandt. Increases in eutrophication potential and heavy metals loading from urban runoff would be the major effects.

If sewerage is provided for the existing population only, future development will not be prevented, but will be forced to utilize a combination of septic tanks and collectors/lift stations/ force mains (unless prohibited by City and County policy initiatives). Ultimate impacts to the watershed will be less (probably significantly less) than if projected future development is serviced by sewerage. Quite simply, the less intensive land use of the non-sewered future population will minimize the concentrations of pollutants generated in urban runoff. This less intensive land use is guaranteed by restrictions on minimum lot size with septic tanks, the likelihood of areas judged unsuitable (and non-permittable) for septic tanks, and the inherent land-use inefficiencies in completely suburbanizing an area with a mosaic mixture of various sewered and non-sewered area. In addition, lack of sewerage will tend to impede the timing of development, even in this relatively attractive area. Therefore additional valuable time may be provided to obtain a water supply of higher integrity. In summary, the water quality impacts to Lake Brandt and Horsepen Creek will be minimized (but far from avoided) by either "No Action" or an alternative that sewers only the existing population.

Strict enforcement of the County Health Department's comprehensive septic tank ordinance will minimize primary surface-water impacts from improperly functioning septic tanks. It should be recognized however that most of the renovated effluent will ultimately discharge to surface streams as base flow and, therefore, to Lake Brandt. Water quality impacts due to renovated effluent, however, will be minor compared to the hazards posed by urban runoff, based on the results of the water-quality study.

As a result of this decision-making process, all alternatives (including "No Action") will provide an impetus toward finding alternative water supplies for the City of Greensboro; none of the options preclude options identified in the Greensboro treatment facilities EIS.

The probabilities of adverse water quality (and aquatic biota) effects due to exfiltration, leakage, and surcharging are considered to be minimized by reducing the number of lift stations and force mains and/or by replacing such facilities by ones with newer materials and more advanced design. In this regard, Alternatives 1E, 1F, 2E, and 2F are most beneficial, in that they eliminate all but one lift station and force main in the Horsepen Creek basin. The No Action alternative and to a lesser extent, the Modified No Action alternative, on the other hand are considered long-term threats to the water quality of Horsepen Creek and other streams in that they maintain the inefficient network of myriad lift stations and force mains. The present system's capacity in the Horsepen basin is sufficient for wastewater transmission there, but City records indicate that the Horsepen wastewater that is pumped to the South Buffalo basin occasionally surcharges the smaller collectors in that basin. While not in the Horsepen basin, this surcharging produces undesireable health-related effects on drainageways in a populated area. (Alternative 6, Modified No Action, would mitigate this effect somewhat by removing Deep River wastewater flow from the Horsepen Creek basin). In addition, while lift station failure and by-passing occurs only very infrequently, the larger number of stations translates to a much higher probability of such occurrence. Even with preventive maintenance, this increase in failure frequency cannot be circumvented.

Since Alternatives 1F and 3F would include larger base flows (from a larger service population and transfer of Deep River basin tributary wastewater), the potential for an adverse impact due to a leak or pump station overflow is somewhat larger for these alternatives than for the other alternatives. In actuality, the difference in these flows is small enough such that this difference in potential harm among the alternatives is probably not significant.

In all alternatives there will be a relatively strong tendency to utilize that portion of the pipeline capacity reserved for peak flows (or otherwise available due to the realities of pipeline sizing) for increasing the service population beyond the design population. This will be particularly the case with those which service only "Existing" conditions (1E, 2E, 3E, and 4E) and with those (2F especially) that provide the most extensive, efficient wastewater collection system. Without some positive initiatives, this condition usually translates into a large chance for system overloads after the design year. Such overloads, in the form of surcharging and bypassing, can lead to adverse public health effects, vector control problems, and disruption of the aquatic ecosystem.

3.2.4 Biological Resources

Short-term biological impacts are largely proportional to the length of the sewer lines, especially gravity sewers. The following reference data are useful:

Alternative	Length of All New Sewers	Length of New Gravity Sewers	Approximate Land Area Disturbed
1E, 1F	58,700 ft.	50,100 ft.	101 acres
2E, 2F	71,700 ft.	51,100 ft.	123 acres
3E, 3F	43,200 ft.	34,600 ft.	74 acres
4E, 4F	56,200 ft.	35,600 ft.	97 acres
No Action (5)	0	0	0
Modified No Action (6)	13,000 ft.	1,000 ft.	22 acres

Because gravity sewers are laid along watercourses, they are of concern with respect to both stream siltation and destruction of the more critical riparian vegetation and bottomland habitat. From an ecological perspective, terrestrial habitat disturbance may not be significantly different between the alternatives, but it may be a significant effect overall. Differences in stream siltation among the alternatives are likely to be more significant, especially since alternatives 1 and 2 are not only longer but cross more erodible area.

Long-term biological impacts relate primarily to habitat attrition/degradation by residential development. Differences among the alternatives may be categorized according to whether they are designed for "existing" or "future" types of development. Ultimately, however, no alternative will prevent virtually complete fragmentation of the natural habitat. Only the timing of this destruction varies among the alternatives.

The principal long-term effect on aquatic biota in Lake Brandt will be the hastened eutrophication of the lake, due to increased light and, to a much lesser extent, nutrients. Oxygen depletion and possibly even toxic loads of some trace elements will be more stressful to aquatic biota of the reservoir.

3.2.5 Cultural (Man-Made Resources)

All alternatives, except No Action, will have direct effects due to construction activities and indirect effects accompanying the use of the facilities. The alternatives are evaluated here by discussing general impacts on the various components of the man-made environment (e.g., demography, transportation, etc.). The environmental trade-offs of each alternative are highlighted.

3.2.5.1 Demography and Economics

An underlying assumption in developing the alternatives has been that 18,700 people will live in the Horsepen Creek basin in 2000. This represents a growth of 10,620 from the 1975 population of 8,080. This growth projection is a constant in this analysis, regardless of the alternative. Furthermore, to project the appropriate size sewer for the various subbasins within the Horsepen Creek basin, it has been assumed that the population will be dispersed uniformly in those undeveloped areas which are not "environmentally sensitive." Based upon the assumptions being employed, there is no difference between the alternatives with respect to population size or distribution. Also, commercial and industrial development should continue as projected regardless of the alternative selected. At this time it does not appear that anyone will be displaced during emplacement of any sewer lines.

The above conclusions actually concern only the indirect effects of facility operations. The direct effects of construction on the economy will vary between alternatives because of the cost. Obviously, "no action" will stimulate no economic activity. However, even the $2.4 million of the most expensive alternative is a relatively small stimulus to local economic activity, and is not considered significant to regional economics.

3.2.5.2 Land Use

The population increase projected for the Horsepen Creek subbasin will cause significant land use change. Regardless of the alternative selected, more of the area will become residential in use. Hence, forests and agricultural land in the subbasin will decline in acreage, especially west of Horsepen Creek.

The major difference between the various alternatives is in the density of development. The No Action and Modified No Action alternatives will cause a considerable part of future development to be on septic tanks. Assuming one-acre lots for septic tank users, the entire subbasin could be developed by the year 2000. Alternatives servicing existing population are identical in this regard, although somewhat more intensive land use than that of "No Action" is anticipated. In the No Action alternative and quite probably in any alternative that services only "existing" development, the resulting land use patterns may increase pressure for development upon land considered to be environmentally sensitive. Such land includes floodplains, airport noise and lake quality buffer zones, and areas with erodible soils and slopes exceeding 15 percent. Sewerage provides a modicum of *de facto* control for guiding growth away from such areas.

All alternatives servicing future population growth will probably result in the development of a smaller percentage of the total basin through the year 2000 because denser residential development is probable. For instance, multi-family units are more likely in the Horsepen Creek basin in areas where municipal sewage treatment is available. Higher density development based upon smaller lot size requirements and a growth of multi-family housing will not require the entire 3107 acres available through the year 2000. For instance, an overall density of just six people per acre would reduce the land required for residential development to 1770 acres through the year 2000.

Ultimately, however, the basin will be totally developed under all the alternatives. The major difference will be the density of this development. The full service alternatives will allow a much higher density development pattern to occur in the basin.

3.2.5.3 Community Services and Facilities

As the population of the Horsepen Creek basin increases, certain services and facilities will have to be provided or extended in that area. Included would be schools, roads, utilities, and so on. The only difference between the various alternatives revolves around the increased cost of providing these services to low density residential areas. The development costs associated with low density development are significantly greater than with higher density development. Hence, No Action must be looked upon as more expensive to Guilford County. It is very important to keep in mind the assumptions utilized in developing these alternatives. The total population in the basin has been fixed.

3.2.5.4 Taxes and Budgeting

The total cost of those alternatives which require construction funds is relatively small, especially compared to the other Section 201 activities which have been proposed (EN-R-618). Given the substantial increase in the tax base provided by the higher income residential area of Horsepen Creek, any of the Horsepen Creek alternatives would not signficantly adversely affect local fiscal conditions. No Action would incur continuing operational and maintenance costs, including replacement costs, for the operation of the existing system of lift stations.

3.2.5.5 Archaeological, Cultural, Historical, and Recreational Resources

The precise routes for the sewage lines have not been firmly established. Hence, it is difficult to assess the potential impact on these resources. An historical and archaeological survey will be conducted on the final routes and the results will be reviewed by the State Historic Preservation Office and State Archaeologist if an alternative other than "No Action" is selected. (No archaeological resources are known along any route at this time.)

A preliminary review of existing inventories for the Horsepen Creek basin does not indicate the existence of historical resources in that area which will be affected by construction activities. The recreational resources of the area will not be affected by construction activities. They may experience more use as the population of the area grows. However, this growth is constant regardless of the alternative selected.

3.2.6 Summary

The results of this alternatives evaluation show that water quality and land use impacts are the most significant to this project. Selection of the No Action or Modified No Action alternatives would encourage low density development throughout the basin. The existing service alternatives would also generally tend to encourage low density development with some higher density development connected to the new sewer line. The future service alternatives will provide for much higher development densities throughout the basin. In the short term, this development will probably be concentrated adjacent to those areas that are currently developed. Ultimately, development will occur throughout the basin.

The less intensive land use densities of existing service alternatives will minimize the concentration of pollutants generated in urban runoff. These alternatives will have a significantly smaller potential adverse impact to water quality in Lake Brandt than the future service alternatives with their substantially higher land use densities.

Other potential adverse impacts to water quality could result from the existing system of lift stations and septic tank failures. The No Action and Modified No Action alternatives would not alleviate these potential hazards. Alternatives 1E and 2E would do the best job in this regard by eliminating all but one lift station. Alternative 2E is considered the most environmentally acceptable alternative since it alleviates the existing problems with the smallest encouragement of high density development.

3.3 Cost Analysis of Alternatives

The engineering alternatives were analyzed based on the estimated existing and future distribution of population in the Horsepen Creek basin as described in Section 3.1. The estimated future sewage flow of 1.3 million gallons per day (MGD) from a projected population of 18,700 persons was used as a basis for pipe sizing. All areas not currently developed or environmentally sensitive were assumed to have a uniform distribution of future inhabitants.

It was assumed that all areas currently serviced by septic tanks would be converted to sanitary sewers. An evaluation of existing line capacities showed over-design far in excess of future needs. Therefore, only the construction of the new lines and pump station as described in Section 3.1 were considered in the cost analysis.

Gravity sewers were costed on the basis of $2.00/inch diameter/foot of length plus $250/mile operation and maintenance cost per year (O&M). Force mains were costed at $1.50/inch diameter/foot of length plus $250/mile O&M. Lift stations were sized using a peaking factor of 2.4 x average inflow. Capital and O&M costs were derived from Stanley Consultants' cost curves. A trend factor of 1.5 was applied to construction costs to bring numbers into current dollars. Present value was calculated on the basis of 6 5/8 percent A.P.R. over a 20-year design period. Useful lives were as follows: pipes = 40 years, lift station structures (1/2 of construction cost) = 40 years, lift station pumps (1/2 of construction cost) = 20 years. Retained existing lift stations were replaced based on their construction date, and salvage value was calculated as of the year 2000. Existing gravity sewers which will remain in use regardless of which alternative is selected were not included in the present value cost analysis.

The costs of the various alternatives are presented in Table 3-3.

3.4 Selection of Proposed Action

Alternative 2E as described above has been selected as the proposed action based upon the environmental analysis as summarized in Section 3.2.6. This alternative is deemed to be the most cost-effective alternative which is environmentally satisfactory.

TABLE 3-3

COST OF ALTERNATIVES

Alternative	Capital ($ million)	O&M ($ thousand/year)	Net Present Worth ($ million)	(rank)
1E	1.82	9.5	1.68	7
1F	2.40	11.3	2.23	9
2E	1.38	8.5	1.28	5
2F	1.83	10.1	1.70	8
3E	1.08	15.5	0.98	2
3F	1.20	19.5	1.19	4
4E	1.19	15.4	1.13	3
4F	1.30	18.6	1.32	6
5	0.34	26.5	0.47	1
6	--	--	--	-

CHAPTER 4

DESCRIPTION OF THE AFFECTED AREA

4.0 DESCRIPTION OF THE AFFECTED AREA

For the purposes of this Environmental Impact Statement (EIS) the study area includes the Horsepen Creek basin as shown in Figure 4-1. The total environment is divided into natural and man-made aspects and each, while interactive, is discussed separately. Components of the existing environment for which no significant impacts are expected as a result of the proposed action (climate, air quality, noise, topography, geology, and elements of the man-made environment) are summarized in the following section. Supporting documentation concerning these areas is provided in the Technical Reference Document (RA-R-406) and the Greensboro EIS (EN-R-687). A more complete discussion of existing conditions is provided here for the soils, water quality, and biology of the Horsepen Creek basin, which are subject to the most significant impacts.

4.1 Environmental Context

Greensboro has a temperate climate characterized by relatively short, mild winters and long, hot summers. Precipitation is abundant. North-northeasterly and south-southeasterly winds prevail during the year as a result of high pressure systems which progress across the eastern United States.

Presently, the general air quality of the study area is good with respect to the criteria pollutants. Guilford County is designated an Air Quality Maintenance Area for suspended particulates. This designation has implications regarding the future growth of suspended particulate levels. Air pollutant emissions in the study area are typical of a moderately industrialized urban region. No community-wide odor problems exist in the study area.

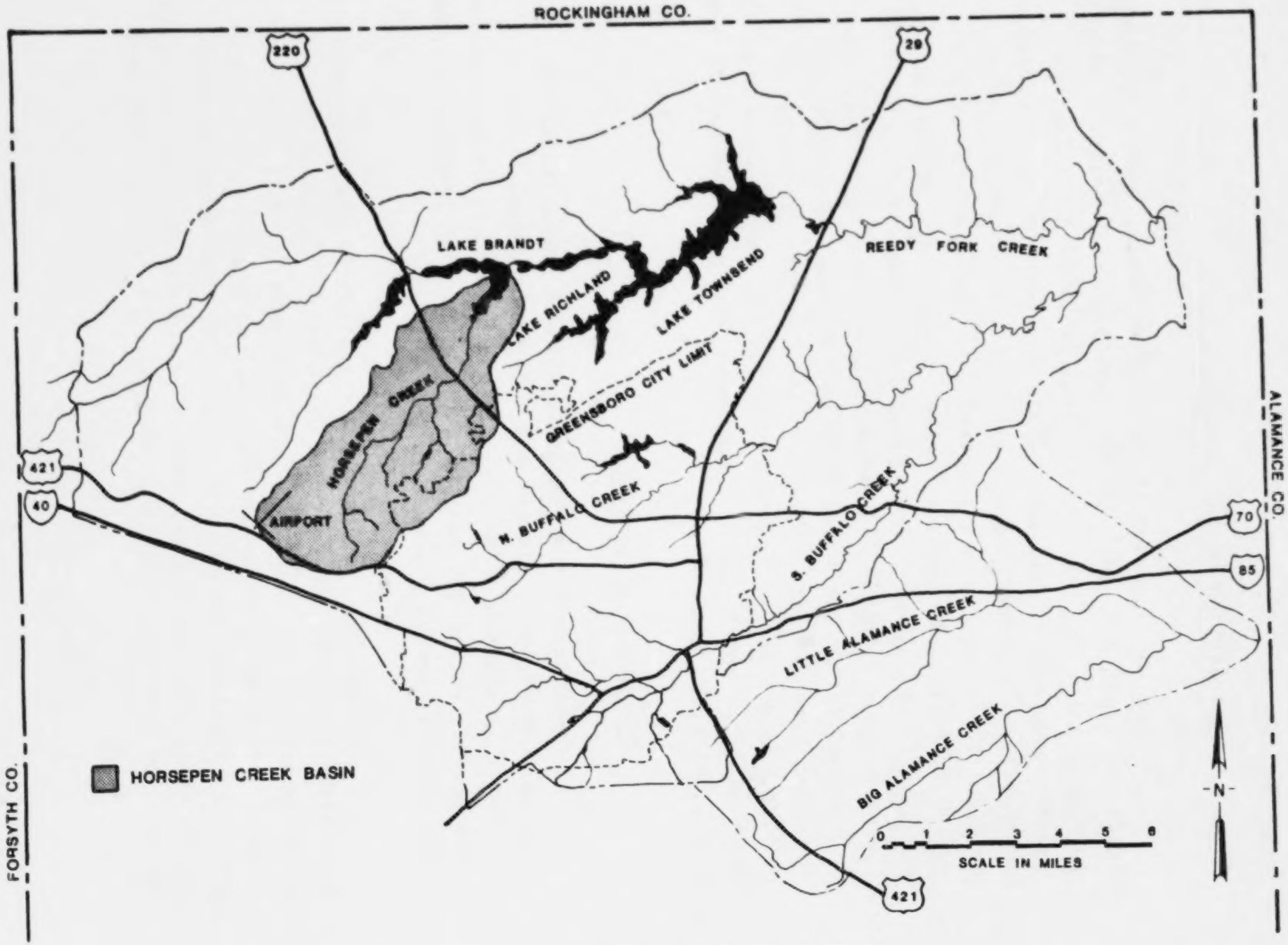

ROCKINGHAM CO.
ALAMANCE CO.
FORSYTH CO.
220
29
421
40
70
85
421
LAKE BRANDT
LAKE RICHLAND
LAKE TOWNSEND
REEDY FORK CREEK
GREENSBORO CITY LIMIT
HORSEPEN CREEK
AIRPORT
N. BUFFALO CREEK
S. BUFFALO CREEK
LITTLE ALAMANCE CREEK
BIG ALAMANCE CREEK
HORSEPEN CREEK BASIN
-N-
0 1 2 3 4 5 6
SCALE IN MILES

Figure 4-1. Horsepen Creek Study Area

The Greensboro area has a noise climate typical of similar metropolitan areas in the United States. Residential areas are characterized by low to moderate levels permitting, in most areas, pursuit of outdoor activities without interference from intruding noise. Zones of higher noise level are near major traffic arteries and the airport.

The topography of Guilford County is typical of the Piedmont Plateau physiographic province in that it is gently rolling in the uplands and somewhat more rugged near the major streams. The bedrock of the county consists of igneous and metamorphic rocks that are also typical of the Piedmont province. The bedrock is overlain by a thick mantle of saprolite (soft, weathered bedrock) in most of the county. The most important geologic processes are ground-water recharge and flooding.

Because of the geologic setting of Guilford County, major regional aquifers do not exist. However, shallow, low-productivity water-table aquifers are present, which serve as important water sources in rural areas. The ground water of these aquifers occurs in pore spaces in the saprolite and in fractures in the underlying bedrock. Recharge to the aquifers occurs in the uplands, and discharge is to wells or as baseflow to the streams. The total ground water available in the county is estimated to be about 150 MGD, but only approximately 11 MGD is presently being used. Ground-water quality is generally good, except for a high iron content in some areas. Ground-water quality problems from septic tanks have been reported in the county.

The Horsepen Creek study area had 8,080 people in 1975 and is projected to have 18,700 in 2000. The land use pattern is a mixture of low-density suburban development along the eastern boundary, commercial and industrial in the southwestern portion, and agricultural and forest land along the western boundary.

The Greensboro area economy has grown since 1970 with 20,000 jobs created in Guilford County from 1970 to 1974. Unemployment has been low in recent years (normally under 4 percent). Manufacturing dominates the employment structure with textile employment being conspicuously important. Employment in manufacturing sectors such as wholesale/retail trade and services has grown in recent years.

Greensboro and Guilford County are providing police and fire protection, health care, education, waste disposal, libraries, and other public services. Greensboro and Guilford County are financially sound governments paying for their needs with very little bonding required.

The Guilford County area has a rich cultural heritage which is being enhanced and protected. National Register historic sites are located in Greensboro and many buildings and areas of historic value have been identified. Also, the area may have archaeological resources, but they are not well known at this time. Recreational resources are scattered throughout the city and county.

As a focal point of North Carolina highways, Greensboro's major thoroughfares are heavily used. Thoroughfares are planned to relieve excess traffic loads as they develop, especially in peripheral areas.

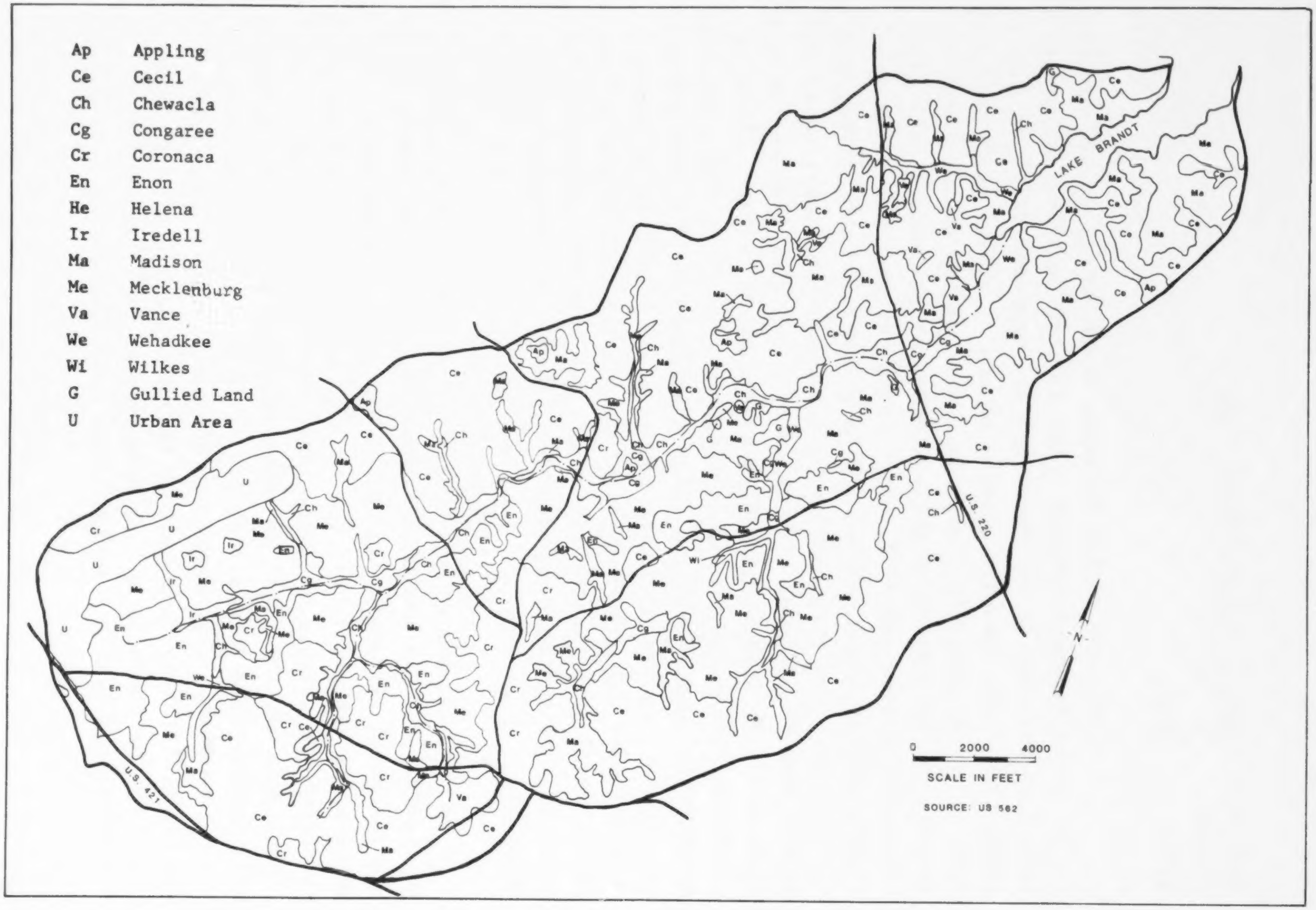
Duke Power Company will be able to meet the area's energy requirements through the year 2000 as long as coal and nuclear fuels are available. No major natural resources are being extracted in the study area.

4.2 Areas of Significant Impact

4.2.1 Soils

The soils of the Horsepen Creek watershed are typical soils of the Piedmont uplands. The surface horizons are generally less than one foot in thickness and are composed of brown loam or sandy loam. The subsoils consist of red or yellow clay and range from 25 to 50 inches in thickness. Most of the upland soils are classed in the Alfisol or Ultisol order of the modern soil classification system (US-517), which indicates that the soils are highly weathered and leached and have developed over a long period of time. The clay content of the topsoil of these soils has washed down (eluviated) into the subsoil, giving rise to the loamy texture of the topsoil and the clayey subsoil texture. Because of the uniformity of bedrock composition (mostly igneous and metamorphic silicate rocks) and the predominance of the time and climate factors in the formation of the soils, the type of parent material does not have a major effect on the soil characteristics. The alluvial soils in the streambeds are less well developed (in terms of horizonation) and are thus classed as Inceptisols or Entisols.

A soil map of the Horsepen Creek basin is presented in Figure 4-2. The map units shown are soil series, which are the basic mapping units of the USDA Soil Conservation Service. A description of the soil series is given in Table 4-1. Examination of Figure 4-2 shows that the primary soil units on the uplands are the Cecil and Mecklenburg series, with the Coronaca, Madison, and Enon series taking in most of the remainder of the upland area. The narrow bottomlands along Horsepen Creek and its tributaries have typical floodplain soils that include primarily the Chewacla and Congaree series with lesser areas covered by the Wehadkee series. The remainder of the soil units


Ap Appling
Ce Cecil
Ch Chewacla
Cg Congaree
Cr Coronaca
En Enon
He Helena
Ir Iredell
Ma Madison
Me Mecklenburg
Va Vance
We Wehadkee
Wi Wilkes
G Gullied Land
U Urban Area
LAKE BRANDT
U.S. 220
U.S. 421
N
0
2000
4000
SCALE IN FEET

SOURCE: US 562

Figure 4-2. Soil Series of the Horsepen Creek Basin

TABLE 4-1
DESCRIPTION OF SOIL SERIES IN HORSEPEN CREEK BASIN

Series	Description
Appling	The Appling series consists of well drained, moderately permeable soils that formed in residuum weathered from acid igneous and metamorphic rocks. These soils are on broad ridges and long, narrow side slopes. Slopes are 2 to 10 percent.
Cecil	The Cecil series consists of well drained, moderately permeable soils that formed in residuum weathered from acid igneous and metamorphic rocks. These soils are on broad to very broad, smooth ridges and on long, narrow side slopes. Slopes are 2 to 15 percent.
Chewacla	The Chewacla series consists of somewhat poorly drained, moderately permeable soils that formed in recent alluvium. These soils are in long, flat areas parallel to the major streams on the floodplains. Slopes are 0 to 2 percent.
Congaree	The Congaree series consists of well drained, moderately permeable soils that formed in loamy alluvium. These soils are on long, narrow floodplains. Slopes are 0 to 2 percent.
Coronaca	The Coronaca series consists of well drained, moderately permeable soils that formed in material weathered from hornblende gneiss, gabbro, and diorite. These soils are on broad, smooth interstream divides. Slopes are 2 to 10 percent.
Enon	The Enon series consists of well drained, slowly permeable soils that formed in residuum weathered from dark colored rocks such as diorite, gabbro, hornblende schist, or mixed acidic and basic rocks. These soils are on broad, smooth interstream divides and long, narrow side slopes. Slopes are 2 to 15 percent
Helena	The Helena series consists of moderately well drained, slowly permeable soils that formed in a mixture of material weathered from acidic and basic crystalline rocks such as aplitic granite or granite gneiss that is cut by dikes of gabbro and diorite. These soils are on long, narrow side slopes. Slopes are 0 to 10 percent.
Iredell	The Iredell series consists of moderately well drained, slowly permeable soils that formed in residuum weathered from diorite, gabbro schist, and other rocks high in content of ferromagnesian minerals. These soils are on flats, in concave areas, and around the heads of intermittent drainageways. Slopes are 0 to 4 percent.
Madison	The Madison series consists of well drained, moderately permeable soils that formed in residuum weathered from acid micaceous metamorphic rock. These soils are on fairly narrow ridges and long, fairly narrow side slopes. Slopes are 2 to 35 percent.
Mecklenburg	The Mecklenburg series consists of well drained, slowly permeable soils that formed in material weathered from dark colored basic rocks such as diorite, gabbro, and hornblende schist. These soils are on broad, smooth interstream divides and long, narrow side slopes. Slopes are 2 to 10 percent.
Vance	The Vance series consists of well drained, slowly permeable soils that formed in residuum weathered from acid crystalline rocks, primarily aplitic granite. These soils are on narrow ridges and long narrow side slopes. Slopes are 2 to 15 percent.
Wehadkee	The Wehadkee series consists of poorly drained, moderately permeable soils that formed in alluvium derived from schist, gneiss, granite, phyllite, and other metamorphic and igneous rocks. These soils are on stream floodplains. Slopes are 0 to 1 percent.
Wilkes	The Wilkes series consists of well drained, moderately slowly permeable soils that formed in residuum weathered from diorite, hornblende schist, and related rocks that are moderately high in content of ferromagnesian minerals or that formed in a mixture of acidic and basic rocks. These soils are on side slopes that generally border drainageways. Slopes are 6 to 45 percent.

Source: US-A-1086

in the basin (Appling, Helena, Iredell, Vance, and Wilkes series) are minor upland soils.

The most significant properties of each soil series are shown in Table 4-2. Also shown in the table are the suitability of each soil series for installation of septic tanks and drainfields. These interpretations are based on ratings of the soils by the Soil Conservation Service for this use (US-562). Most of the soil units present in the Horsepen Creek basin are not well suited for septic tank use. The upland soils are poorly suited primarily because of the low permeability of the clayey subsoil. The lowland soils are unsuited for septic tank use because they are saturated or frequently flooded.

The interpretations of the soil series map units in terms of their suitability for septic tank use can be used in conjunction with the soil map in Figure 4-2 to formulate a septic tank suitability map. This map, which is shown in Figure 4-3, shows quite graphically the relative suitability of the soils for septic tank use. Most of the soils of the area have been given a "fair to poor" rating. These soils occur over a large part of the upland portion of the basin in a wide area adjoining the basin boundaries. The central part of the basin, including the creeks, is classified in the "poor" suitability category. The best-rated soils, which are given a only a "fair" rating, occur in a smaller part of the basin, primarily in an upland area south of Horsepen Creek.

In summary, the soils of the Horsepen Creek basin are generally not well suited for septic tank and drainfield installations. Locally, areas where septic tanks will perform adequately may be found. Such areas generally cannot be discerned without site-specific testing. The overall poor suitability of soils in

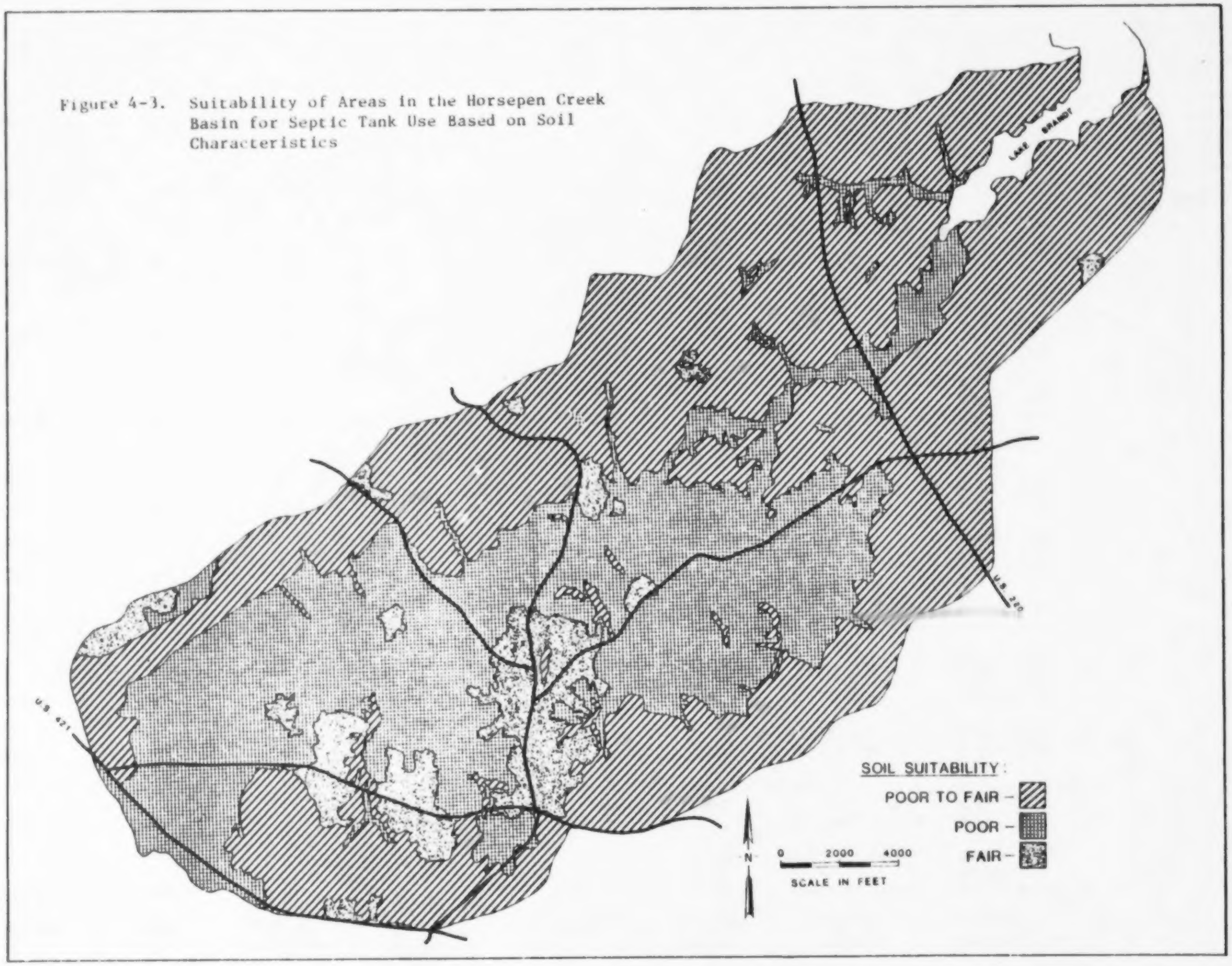
TABLE 4-2

PHYSICAL PROPERTIES OF SOIL SERIES

Series	Map Symbol	Hydrologic Group	Erodibility Factors K	Erodibility Factors T	Septic Tank Suitability	Horizon (inches)	*USDA Class	Permeability (in/hr)
Appling	Ap	B	.32	4	Fair	0-10 10-54 54-60	cosl, sl, fsl c, sc scl, cl, sl	2.0 - 6.3 0.63 - 2.0 0.63 - 2.0
Cecil	Ce	B	.32	4	Fair to Poor	0-7 7-50 50-75	sl, fsl, l c cl, l	2.0 - 6.3 0.63 - 2.0 0.63 - 2.0
Chewacla	Ch	C	--	--	Poor	0-14 14-58	fsl, l, sl sl, l, cl	0.63 - 2.0 0.63 - 2.0
Congaree	Cg	B	--	--	Poor	0-8 8-38 38-62	l l scl	0.63 - 6.3 0.63 - 6.3 0.63 - 2.0
Coronaca	Cr	B	.24	5	Fair	0-6 6-80	scl, cl, l c	0.6 - 2.0 0.6 - 2.0
Enon	En	C	.37	4	Poor	0-7 7-34 34-50+	fsl, sl c cl	2.0 - 6.3 0.06 - 0.20 0.06 - 0.20
Helena	He	C	.37	3	Poor	0-12 12-19 19-46 46-60	sl, fsl scl, cl c, sc sl	2.0 - 6.3 0.20 - 0.63 < 0.2 0.2 - 6.3
Iredell	Ir	D	.43	3	Poor	0-7 7-24 24-27 27-40	sl c l sl	2.0 - 6.3 0.06 - 0.20 0.06 - 2.0 0.63 - 2.0
Madison	Ma	B	.32	4	Fair to Poor	0-7 7-30 30-44	grfsl c to cl sl	< 6.3 0.63 - 2.0 0.63 - 2.0
Mecklenburg	Me	C	.37	4	Poor to Fair	0-6 6-36 36-48	l, sil, sl c cl, l	0.63 - 2.0 0.06 - 0.20 0.2 - 0.63
Vance	Va	C	.37	3	Poor	0-6 6-40 40-60	cosl, sl, fsl c, sc l, scl, cl	2.0 - 6.3 0.06 - 0.20 0.06 - 0.20
Wehadkee	We	D	--	--	Poor	0-8 8-40 40-50	fsl, l, sl l, sc sl	2.0 - 6.3 0.63 - 2.0 2.0 - 6.3
Wilkes	Wi	C	.28	2	Poor	0-6 6-13 30-48	sl, l cl, c, scl sl, l	2.0 - 6.0 0.2 - 0.6 0.6 - 2.0

***USDA CLASS**

l	- loam
c	- clay
cl	- clay loam
sl	- sandy loam
sc	- sandy clay
sil	- silt loam
scl	- sandy clay loam
fsl	- fine sandy loam
cosl	- coarse sandy loam
grfsl	- gravelly fine sandy loam



LAKE BRANDT
U.S. 220
U.S. 421
SOIL SUITABILITY:
POOR TO FAIR – ▨
POOR – ▦
FAIR –
N
0 2000 4000
SCALE IN FEET

Figure 4-3. Suitability of Areas in the Horsepen Creek Basin for Septic Tank Use Based on Soil Characteristics

Figure 4-3. Suitability of Areas in the Horsepen Creek Basin for Septic Tank Use Based on Soil Characteristics

the basin for septic tank use underscores the importance of intensive site specific soil tests before a permit for any new septic tanks is issued.

Many of the soil series present in the Horsepen Creek basin contain soils that have prime farmland characteristics. That is, some of the mapping subunits of the soils series (i.e., soil phases) have been classed as prime farmlands by the USDA Soil Conservation Service (BY-A-015). Figure 4-4 shows that most of the Horsepen Creek basin is underlain by soil series that are wholly or in part prime farmlands.

4.2.2 Water Quality

4.2.2.1 Ground-Water Quality

The natural ground-water quality in the Greensboro area is quite good. Probably the most troublesome water quality problem is an objectionably high iron content in some areas. A more serious ground-water problem in the Greensboro area is that of aquifer pollution from man-made sources. The most serious and widespread threat to ground-water quality is from numerous septic tanks in the area. Where septic tank density is not too great, the thick soils and saprolite in most areas should serve to renovate the septic tank effluent quite well before it reaches any aquifer systems. In many areas, however, low permeability or insufficient soil thickness limits the number of septic tanks that can be accommodated satisfactorily. It appears that the safe number of septic tanks has already been exceeded in some places, owing primarily to poor siting and/or maintenance. Most of the county is considered to have about the same potential for site-specific problems and ground-water quality degradation from septic tanks.

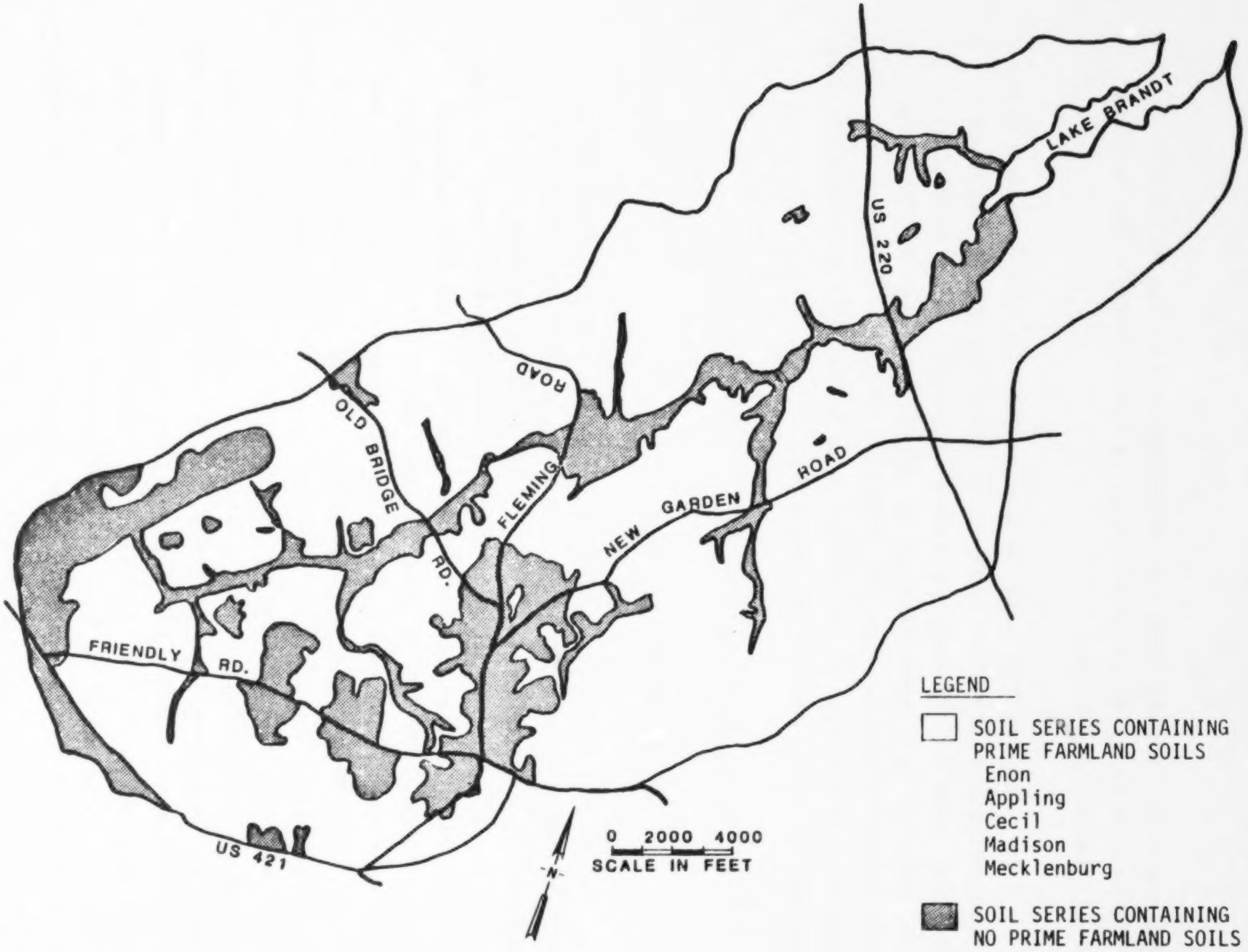

LAKE BRANDT
US 220
ROAD
NEW GARDEN ROAD
FLEMING
OLD BRIDGE RD.
FRIENDLY RD.
US 421
N
0 2000 4000
SCALE IN FEET
LEGEND
☐ SOIL SERIES CONTAINING PRIME FARMLAND SOILS
Enon
Appling
Cecil
Madison
Mecklenburg
▨ SOIL SERIES CONTAINING NO PRIME FARMLAND SOILS

Figure 4-4. Occurrence of Prime Farmland Soils in the Horsepen Creek Basin

4.2.2.2 Surface-Water Quality

4.2.2.2.1 General Description

Information reviewed for assessing existing water quality conditions of the area streams and lakes in the EIS study area included data from the City of Greensboro, the North Carolina Division of Environmental Management Monitoring Survey, University of North Carolina at Chapel Hill, Guilford College, and Radian Corporation. Combining and correlating data from these sources provide a basis for describing present water quality conditions in the study area and identifying problem sources which affect surface water quality.

Non-Point Waste Sources

Non-point source pollution occurs as a result of storm water runoff. Some of the major contributors are urban runoff, agricultural runoff, runoff from construction activity, and septic tanks. The type and amount of contaminants in surface runoff will vary largely as a function of land use. In urban areas contaminants accumulate in the streets and on land surfaces between storm events. During storm runoff, the contaminants are carried to the receiving stream and can cause significant degradation of stream water quality. In addition, soil erosion currently contributes more than 150 tons of sediment per square mile to streams in Guilford County (SI-138).

Area Stream Water Quality Classifications

Shown in Figure 4-5 are the monitoring sites operated by the NCDEM and the City of Greensboro. Water quality data from these sites were used to assess present conditions of area streams. The State of North Carolina Division of Environmental

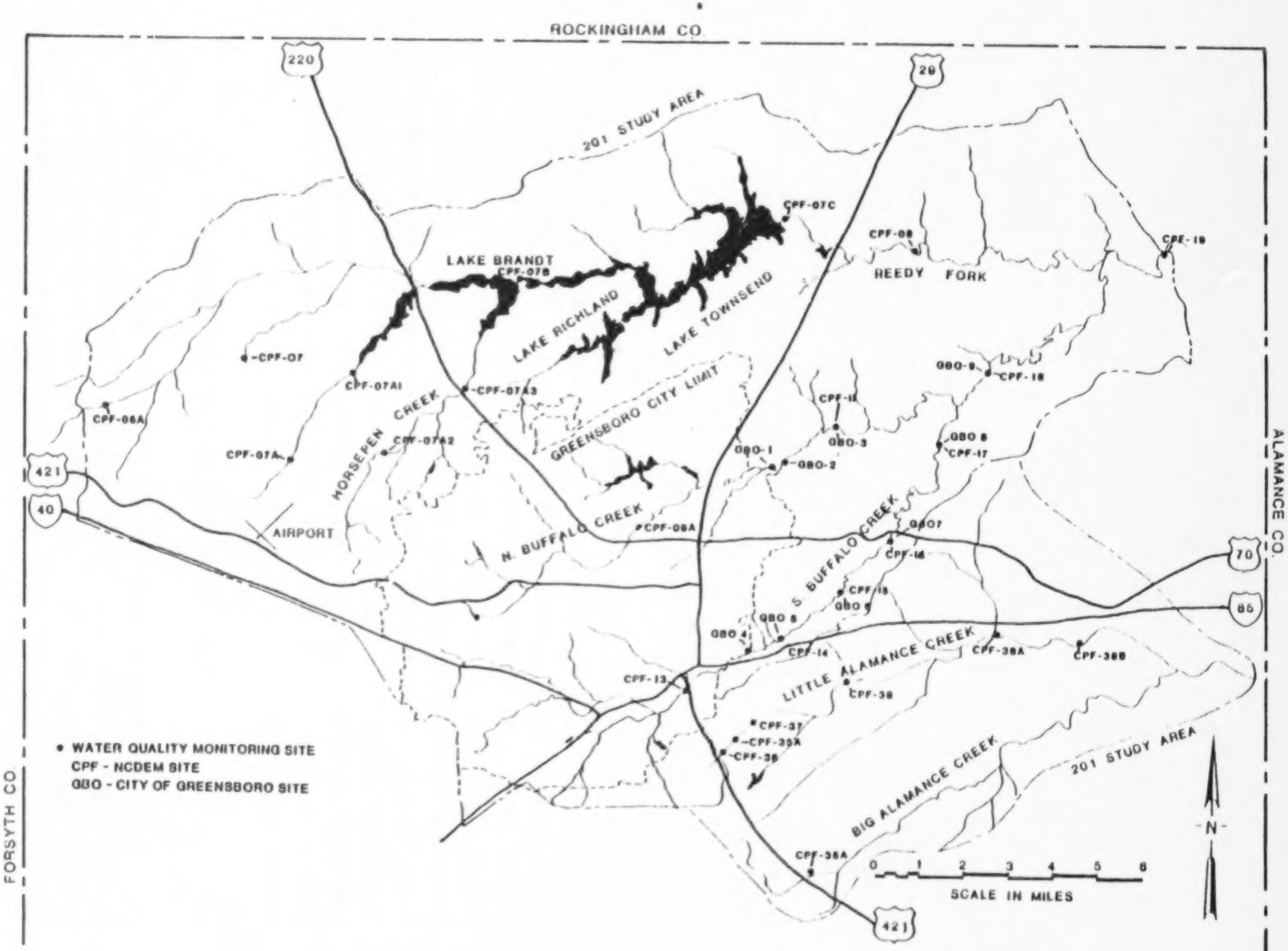

ROCKINGHAM CO.
ALAMANCE CO.
FORSYTH CO.
220
29
70
85
421
40
201 STUDY AREA
LAKE BRANDT
CPF-07B
LAKE RICHLAND
LAKE TOWNSEND
CPF-07C
CPF-08
REEDY FORK
CPF-19
CPF-07
CPF-07A1
CPF-07A3
CPF-06A
CPF-07A
CPF-07A2
HORSEPEN CREEK
GREENSBORO CITY LIMIT
GBO-9
CPF-18
CPF-11
GBO-3
GBO-1
GBO-2
GBO 8
CPF-17
AIRPORT
N. BUFFALO CREEK
CPF-09A
S. BUFFALO CREEK
GBO7
CPF-16
CPF-15
GBO 6
GBO 4
GBO 5
CPF-14
CPF-13
LITTLE ALAMANCE CREEK
CPF-38A
CPF-38B
CPF-38
CPF-37
CPF-39A
CPF-39
BIG ALAMANCE CREEK
CPF-36A
201 STUDY AREA
0
1
2
3
4
5
6
SCALE IN MILES
N
• WATER QUALITY MONITORING SITE
CPF - NCDEM SITE
GBO - CITY OF GREENSBORO SITE

Figure 4-5. Water Quality Monitoring Sites Within Study Area

Management has classified area surface water according to the best intended use of those waters. Stream segments within the study area are classified as shown in Table 4-3. Class A-II waters are intended for use as water supply for drinking or food processing. The intended uses for Class C waters are for fishing, boating, wading and other uses except for bathing and water supply.

TABLE 4-3

STATE OF NORTH CAROLINA WATER QUALITY CLASSIFICATION OF GUILFORD COUNTY STREAMS

Stream Segment	Class
Reedy Fork (west)	A-II
Moores Creek	A-II
Brush Creek	A-II
Horsepen Creek	A-II
South Buffalo Creek	C
North Buffalo Creek	C
Buffalo Creek	C
Reedy Fork (east)	C
Big Alamance Creek	A-II
Little Alamance Creek	A-II
Alamance Creek	A-II

4.2.2.2.2 Horsepen Creek

Basin Description

The Horsepen Creek watershed is located just north and mostly outside the city limits of Greensboro (see Figure 4-1). The average width of the basin is about 3 miles, and the length of the main channel is more than 7 miles. The average channel slope is 15.5 feet per mile with much steeper slopes than this in the headwaters and tributaries. A summary of average stream discharge and 7-day, once-in-10-year low flows (as estimated by the U.S.G.S.) is presented in Table 4-4 for creeks in the Greensboro area.

Except for isolated sections, the floodplain is relatively narrow and contains little development. Much of the floodplain in the lower section of the creek is marshland that serves as a natural deterrent to development. Sections of the floodplain in the upper basin have protective restrictions limiting future growth along the creek. With the exception of Guilford College, most of the area consists of moderate- to low-density residential developments. An isolated tract southeast of the regional airport contains the only well-developed industrial area.

Horsepen Creek Water Quality

The NCDEM operated two water quality monitoring sites on Horsepen Creek from February, 1974 to April, 1975. Analysis of the data shows Horsepen Creek to be of high water quality. Dissolved oxygen levels are high, and B.O.D. levels are low. Malfunctioning septic tanks are known to exist in the Horsepen Creek basin. Data from the NCDEM monitoring site on Horsepen Creek located at SR 2136 indicate that contamination by fecal coliforms presently exists. The average count per 100 ml for seven samples was 2985. However, this value does not contravene stream standards for a Class A-II stream. Data from seven samples taken at the downstream NCDEM monitoring site at Horsepen Creek and U.S. 220 show that the average fecal coliform count had decayed to 260/100 ml.

TABLE 4-4

DRAINAGE AREAS, AVERAGE DISCHARGE, AND 7-DAY-ONCE-IN-10-YEAR FLOW FLOW DETERMINATIONS FOR SELECTED STREAM SITES NEAR GREENSBORO, NORTH CAROLINA

	Drainage Area (sq. mi.*)	Average Discharge (cfs**)	7-Day-Once-In 10-Year Low Flow (cfs)	Unit Values (per square mile)	
				Average Discharge (cfs/sq. mi.)	7-Day-Once-In 10-Year Low Flow cfs/sq. mi.
NATURAL WATERSHEDS					
1. Upper Reedy Fork (above lakes)	19.9	22.7	3.7	1.13	.186
2. Reedy Fork (below lakes)	133	101	13.0	.76	.098
2a. Reedy Fork (below Buffalo Creek)	254	280	15.0	1.10	.059
3. Big Alamance (below Little Alamance)	116	113	1.7	.97	.015
DEVELOPING WATERSHEDS					
4. Horsepen	15.9	17.3	1.7	1.09	.017
5. Little Alamance	30.5	27.0	.5	.89	.016
6. East Fork, Deep River	14.7	15.8	2.1	1.07	.146
URBAN WATERSHEDS					
7. North Buffalo (above S.T.P.)†	21.7	24.0	1.50	1.11	.069
8. South Buffalo	29.6	28.0	.95	.95	.032
9. Buffalo	100.0	105.0	7.00	1.05	.070

* Square Mile

** Cubic feet per second

† Sewage Treatment Plant

SOURCE: NO-111

4.2.2.2.3 Reservoir Water Quality

Lake Higgins, Lake Brandt, Lake Richland, and Lake Townsend form the reservoir system that provides Greensboro's raw water supply. Due to the limited water supply, protection of this reservoir system is widely perceived as a necessity. Sediment-laden storm runoff is by far the most significant non-point source pollutant.

Table 4-5 shows stratification characteristics of Lake Brandt. Tables 4-6 and 4-7 show average chemical and physical characteristics of raw water withdrawn from Lake Brandt and Lake Townsend, respectively. The only significant difference in water quality of these two sources is the higher concentration of iron (Fe) occurring in Lake Brandt. Physicochemical characteristics of these two lakes (RA-R-406) indicate that temperature stratification occurs during the summer, which produces partial to complete oxygen depletion in bottom water and probably significantly increases nutrient concentrations during the fall overturn event. However, it appears unlikely that these water quality changes are now accompanied by particularly adverse biological responses, probably due to the small detention time of these impoundments. However, eutrophication is a potential hazard to the quality of the reservoir water.

General Description of Lake Brandt

The drainage area of Lake Brandt is approximately 70 square miles (Figure 4-6). Horsepen Creek drains 16 mi^2. Brush Creek drains 12 mi^2 into Lake Higgins, with the excess being released to Lake Brandt. Reedy Fork Creek drains 32 mi^2 with about 10 mi^2 draining directly into the lake. U.S.G.S. historical flow

TABLE 4-5

STRATIFICATION CHARACTERISTICS OF LAKE BRANDT
17 JULY 1969

Depth (Ft.)	Temp. (°F)	Dissolved Oxygen (mg/ℓ)
Surface	88.1	8.0
2	86.9	7.5
4	84.7	7.5
6	84.1	7.5
8	83.7	7.5
10	80.0	7.0
12	77.2	6.0
14	72.3	1.5
16	67.8	0.0
18	66.5	0.0
20	65.8	0.0

Bottom depth is 36 feet

Source: VA-157

records indicate Reedy Fork delivers an average of 1.14 cubic feet of water per second per square mile (cfs/mi^2) to Lake Brandt, and Horsepen Creek delivers 0.92 cfs/mi^2.

The topography of the area is gently rolling with basin slopes ranging from 5% to 20%. The steeper slopes generally occur in the Brush and Reedy Fork Creek basins, with the Horsepen Creek basin having slopes ranging from 5% to 10%.

Lake Brandt is located in the northern Piedmont region of North Carolina. The primary function of the reservoir is to provide raw water for the City of Greensboro. Secondary functions are noncontact recreation such as fishing and duck hunting.

TABLE 4-5

STRATIFICATION CHARACTERISTICS OF LAKE BRANDT
17 JULY 1969

Depth (Ft.)	Temp. (°F)	Dissolved Oxygen (mg/ℓ)
Surface	88.1	8.0
2	86.9	7.5
4	84.7	7.5
6	84.1	7.5
8	83.7	7.5
10	80.0	7.0
12	77.2	6.0
14	72.3	1.5
16	67.8	0.0
18	66.5	0.0
20	65.8	0.0

Bottom depth is 36 feet

Source: VA-157

records indicate Reedy Fork delivers an average of 1.14 cubic feet of water per second per square mile (cfs/mi^2) to Lake Brandt, and Horsepen Creek delivers 0.92 cfs/mi^2.

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Lake Brandt is located in the northern Piedmont region of North Carolina. The primary function of the reservoir is to provide raw water for the City of Greensboro. Secondary functions are noncontact recreation such as fishing and duck hunting.

TABLE 4-6

CHEMICAL AND PHYSICAL CHARACTERISTICS OF RAW WATER SUPPLY FROM LAKE BRANDT

(Expressed as mg/ℓ)

Year	pH	Hardness	Alkalinity	CO_2	Fe	Mn	Tur	Color
1961-62	7.0	27	24	6	.75	.52		
1962-63	7.2	24	25	5	.89	.32		146
1963-64	7.2	24	26	5	.87	.18	12	51
1964-65	6.9	19	22	5	1.33	.20	20	135
1965-66	6.9	22	22	5	1.54	.31	47	140
1966-67	7.1	30	31	4	.65	.19	14	42
1967-68	7.0	32	26	4	.77	.15	16	71
1968-69	7.0	32	27	5	1.03	.23	30	83
1969-70	6.6	34	26	6	.79	.19	16	74
1970-71	6.8	30	27	7	1.52	.19	23	70
1971-72	6.8	30	27	9	.88	.26	13	97
1972-73	6.9	31	27	6	.72	.22	18	105

Source: GR-280

TABLE 4-7

CHEMICAL AND PHYSICAL CHARACTERISTICS OF RAW WATER SUPPLY FROM LAKE TOWNSEND

(Expressed as mg/ℓ)

Year	pH	Hardness	Alkalinity	CO_2	Fe	Mn	Tur	Color
1969-70	6.7	38	31	6	.44	.17	11	39
1970-71	7.0	37	31	5	.30	.25	5	27
1971-72	7.0	30	28	6	.28	.15	8	46
1972-73	7.0	32	29	6	.35	.18	9	38
1973-74	--	--	--	--	.42	.22	--	--
1975-76	6.6	33	27	4.3	.15	.03	10.5	45

Source: GR-280

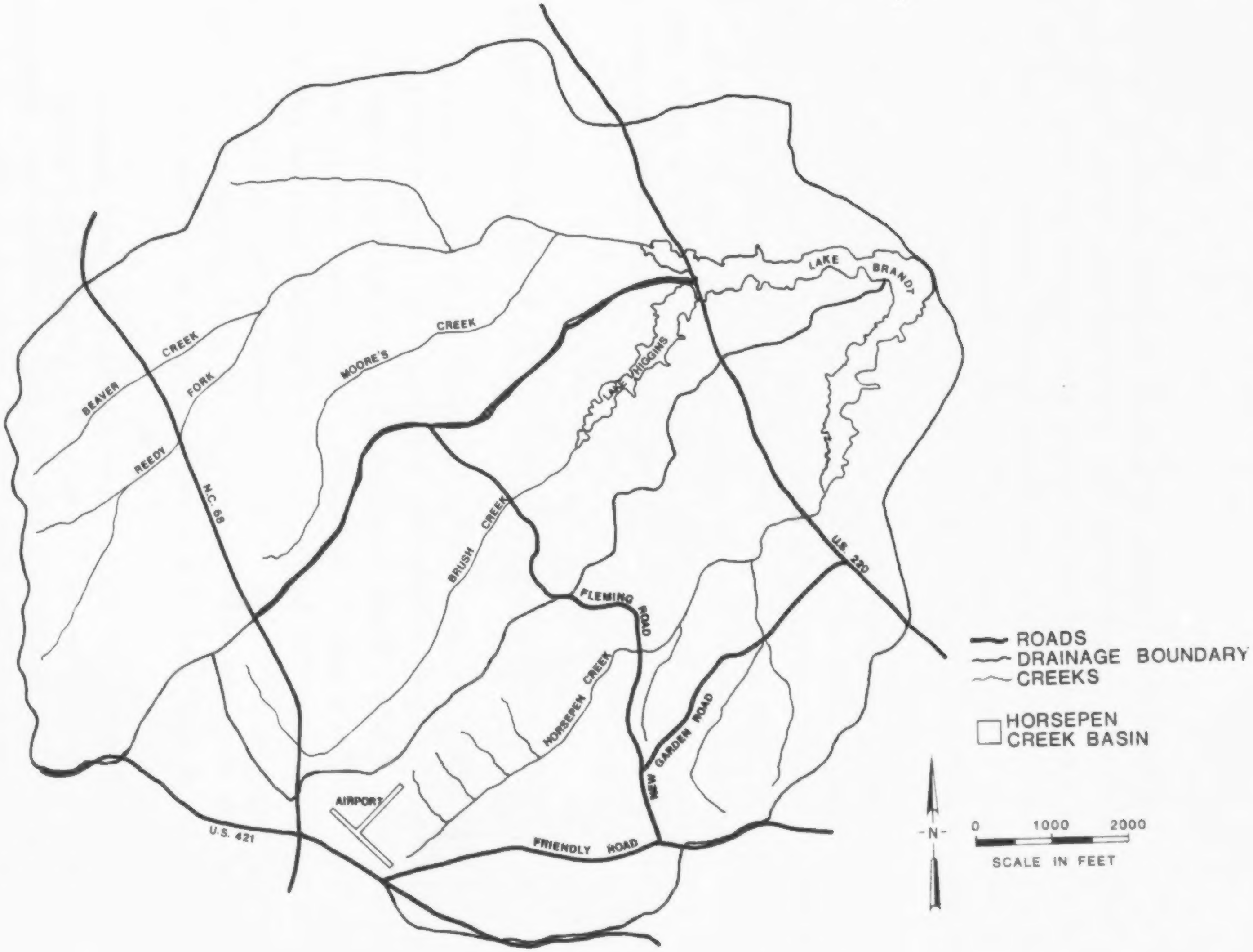

LAKE BRANDT
LAKE HIGGINS
BEAVER CREEK
REEDY FORK
MOORE'S CREEK
BRUSH CREEK
HORSEPEN CREEK
N.C. 68
U.S. 220
U.S. 421
FLEMING ROAD
NEW GARDEN ROAD
FRIENDLY ROAD
AIRPORT
ROADS
DRAINAGE BOUNDARY
CREEKS
HORSEPEN CREEK BASIN
N
0
1000
2000
SCALE IN FEET

Figure 4-6. Location Map of the Lake Brandt and Horsepen Creek Drainage Areas

Impoundment of water commenced in 1923 at which time the water surface elevation was 736 feet mean sea level (MSL). In 1959, the lake was raised by seven feet to its present elevation of 743 feet MSL. The lake has a present volume of 6,750 acre-feet and a surface area of 800 acres. Maximum depth is approximately 20 feet and average depth is 8.4 feet.

Lake Brandt is monomictic in nature, being completely mixed and usually free of ice in winter, and thermally stratified in summer. Lake profiles have shown that in 1977 and other years, late summer warming pushed the region of the thermocline to the bottom, thereby eliminating thermal stratification. It is not well documented that this occurs every year. The dry summer of 1977 caused the lake to drop 4-5 feet, creating a situation conducive to warming throughout.

Existing Water Quality and Trophic State of Lake Brandt

Sampling on Lake Brandt has been performed by several organizations. These include the University of North Carolina at Chapel Hill (UNC), North Carolina Division of Environmental Management (NCDEM), City of Greensboro, Guilford College, and Radian Corporation. The Radian-Guilford College program (RA-R-507) has been the most intensive to date. Sampling has been done at several sites in both arms of the lake on several occasions over the 1977 season. Radian sampling sites are shown on Figure 4-7.

Examination of data indicates fair to good overall water quality in Lake Brandt. The water is soft, and conductivity readings are moderately low (50-150 micromhos/cm), indicating low levels of dissolved solids. pH measurements generally show slightly acid to neutral conditions typical of waters draining forested areas. However, wide seasonal variations in pH have occurred. In 1977 alone, pH levels both greater than 8.5 and less

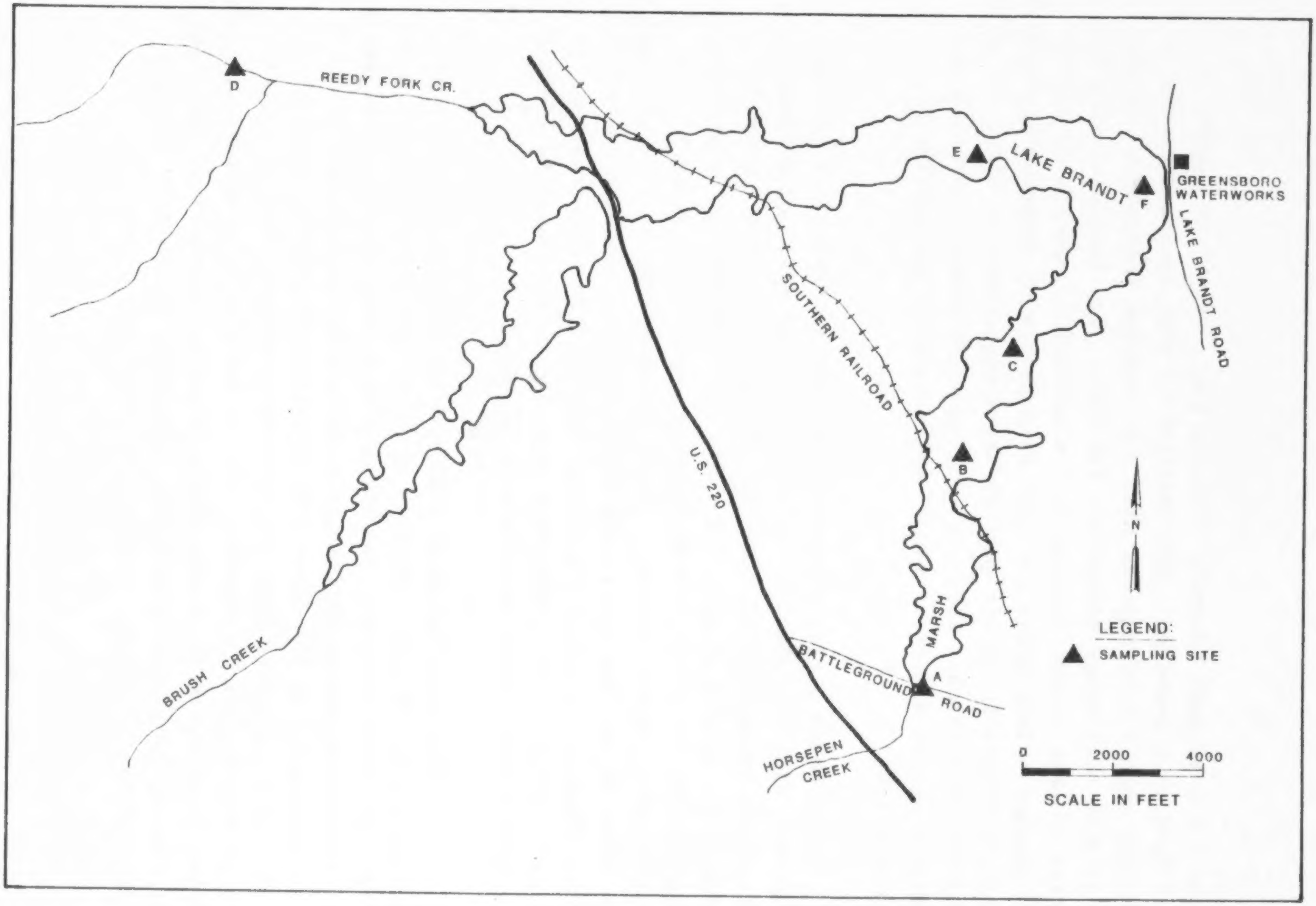

D
REEDY FORK CR.
E
LAKE BRANDT
F
GREENSBORO WATERWORKS
LAKE BRANDT ROAD
SOUTHERN RAILROAD
C
B
U.S. 220
N
MARSH
A
BATTLEGROUND ROAD
BRUSH CREEK
HORSEPEN CREEK
LEGEND:
SAMPLING SITE
0
2000
4000
SCALE IN FEET

Figure 4-7. Water Quality Sampling Stations on Lake Brandt and its Tributaries

02-2111-2

than 5.5 have been recorded. In the past, values in excess of 9.0 have been measured. Many species of fish cannot thrive in a pH less than 6.0 or greater than 9.0, and few tolerate an environment with such large variations (NA-199). The low total alkalinities in Lake Brandt provide little buffering capacity to resist pH changes. This makes the lake susceptible to upstream discharges and variations in runoff quality which might tend to alter the pH. Changes in watershed land use away from the natural forested conditions may be affecting runoff water quality and causing pH fluctuations.

Heavy metals concentrations are generally low and acceptable with two possible exceptions: lead (Pb) and arsenic (As). To ensure protection of fishlife, maximum concentration of Pb should not exceed 30 μg/ℓ (NA-199). The maximum set by federal regulations for public drinking water supplies is 50 μg/ℓ. In August 1977, Radian recorded levels in Lake Brandt of 40 μg/ℓ and 60 μg/ℓ, at the dam and in the Horsepen Creek arm, respectively. Other sampling occasions have not indicated Pb concentrations as great. Future conditions which may lead to increased Pb loadings to Lake Brandt should be carefully examined.

The drinking water standard for maximum arsenic concentration is 50 μg/ℓ. Whereas no levels in excess of that standard have been recorded, Radian samples indicated a possible trend of increasing concentrations in both arms of Lake Brandt from the headwaters to the dam. Inflow concentrations were on the order of 1 μg/ℓ, and lake concentrations ranged from 10.8 μg/ℓ to 16.8 μg/ℓ. It is possible that As-containing sediments are being recycled under acidic and/or chemically reducing conditions. Sources of As in the Lake Brandt watershed are unknown at this time.

The trophic state of the lake is best described as moderately eutrophic. During early summer, the lake is thermally stratified and characterized by hypolimnetic oxygen depletion. Toward late summer, thermal stratification can disappear as the region of the thermocline approaches the bottom. Even without thermal stratification, there is noticeable chemical stratification. Significant oxygen depression with increasing depth is still recorded at both deep and shallow stations. This indicates a considerable degree of organic decay processes and concomitant biological activity within the Lake Brandt ecosystem.

Aquatic macronutrients, i.e., nitrogen (N) and phosphorus (P), while not present in extreme concentrations, are present in quantities more than adequate for excessive growth of aquatic vegetation. Typical Lake Brandt concentrations have been in the vicinity of 1.0 mg/ℓ inorganic -N and .05 mg/ℓ ortho-P (the major inorganic P-form).

Sampling data indicate that if a macronutrient is indeed limiting algal growth in Lake Brandt, it is probably phosphorus. A normal ratio of N:P uptake by algae is approximately 10:1 (MA-743). Except for the samples taken by UNC on 2 April 1975 (N/P = 4.3) (WE-304), N:P ratios have exceeded this value. Despite Lake Brandt's somewhat nutrient-rich state, neither stands of aquatic macrophytes nor nuisance algal blooms have developed. The probable critical factor in this case is the extremely turbid nature of the water. Measured Secchi disc depths have been on the order of only one foot. Runoff in the watershed contains large amounts of clay which produce a non-settling suspension. Hence, it is likely that persistent, high suspended solids concentrations limit algal growth through reduced light penetration.

Lake Brandt is particularly susceptible to nutrient inputs because it is so shallow. Most lakes and reservoirs act as nutrient "traps" or sinks. Much of the incoming nutrient loading ends up settling with the sediment. The deeper the lake and the longer its detention time, the more effective the sink. Radian's calculations indicate that Lake Brandt's mean depth is 8.4 ft and its average hydraulic detention time is 46 days. This makes the lake sensitive to changes in quality of stream inflow. Much of the nutrient input remains in the epilimnion and is therefore available for plant uptake. Furthermore, the lack of thermal stratification in late summer makes scouring of nutrient-rich benthic deposits possible. Therefore, Lake Brandt is very likely to remain in a eutrophic state. If there is a significant change in the water quality in Horsepen Creek and/or Reedy Fork, this change is likely to be felt fairly rapidly in Lake Brandt.

4.2.3 Biological Components

4.2.3.1 Terrestrial Environment

4.2.3.1.1 Vegetation Types

Potential Natural Vegetation

As influenced by topography, climate, and soils, a climax hardwood forest developed in Guilford County which was dominated on upland sites by white, red, and black oaks, and with post, blackjack, southern red and scarlet oaks achieving prominence on the drier sites. Floodplains and low-lying moist sites were dominated by willow oak, swamp red-oak, and shagbark hickory; beech was found in sheltered ravines (00-004).

Today, almost no virgin forest remains of the original climax cover of the North Carolina Piedmont. Clearing of the native forests for lumber began about 1750 (FU-072) and the cutover areas were subsequently cleared for agriculture. Fields were cultivated until erosion and cropping reduced their fertility past the point of economic return and were then abandoned.

Present Vegetation

The mixed pine-hardwood stands are the most common type of forest cover in the study area; there are late-successional stands resulting from regrowth following logging or cultivation. Species composition varies considerably, and a continuum of stands occurs between the driest, best-drained sites and the moister, richer sites in sheltered ravines and lower slopes. Though basically dominated throughout by white, red, and black oaks, the drier end of the continuum is distinguished by scarlet, post, and blackjack oaks, with chestnut oak on the most rugged sites. The opposite end of the continuum is characterized by the presence of American beech, sweetgum, green ash, shagbark hickory, and walnut. Pines may be found on all sites, usually as scattered clusters or individuals of shortleaf pine. The upland forests correspond roughly to ASF Types 52, 78, and 87, but their successional nature makes them indistinct, and the degree of overlap is so great as to justify no ecological distinction between them.

Floodplain forests are very restricted in distribution owing both to the fact that the study area lies at the headwaters of a drainage basin and to the encroachment of agriculture and industry. Several successional phases of this forest type are evident, but the most common appears to be dominated by American elm and/or green ash, and corresponds roughly to ASF Type 93. Riparian woodlands are a subtype of this floodplain forest type, forming a narrow strip on either side of stream courses. Sycamore is clearly the most characteristic tree of streambank situations, together with American elm and green ash. Black willow is found on disturbed sites. Japanese honeysuckle frequently forms an almost continuous carpet over the forest floor, and other vines, including poison ivy, Virginia creeper, and grape are common.

The pine woodlands in the study area are almost always nearly pure stands of Virginia pine grown very close together and forming a dense canopy. Occasional plantations of shortleaf pine are found. Virginia redcedar is frequently encountered as an understory species in successional stands of pine. Elsewhere, redcedar is a typical early-succession dominant on abandoned fields; in the study area, one heavily grazed field was observed in which redcedar had established itself in the absence of pine.

Old field revegetation varies according to time elapsed since abandonment, with broomsedge becoming dominant, together with various tall, weedy forbs. Pine seedlings may invade as early as the third year. Farm and pasture make up a sizeable percentage of the study area, occupying 18 percent of the total non-urban land. Corn, tobacco, cotton, and feed grains are the most frequently grown crops.

Sensitive Botanical Areas

Reports (HA-544; CO-582) indicate that sensitive plant species may be found in the study area. Ginseng is a plant nearly extirpated in pioneer days when it was dug and sold for its supposedly medicinal qualities. It is found in rich woods and, consequently, would be expected to be restricted in Guilford County to floodplain forests and the moist end of the upland hardwoods continuum. The southern rain-orchid (*Habenaria flava*) and Nestronia (*Nestronia umbellula*) are listed as "threatened throughout" their range in North Carolina. The orchid is a moist lowland species and Nestronia occurs in the more moist mixed hardwood stands. None of these species were found during site visits.

4.2.3.1.2 Fauna

Relationship to Habitat

Generally speaking, the more open upland and floodplain forests provide the best habitat for most wildlife species. Both cover and food are abundant, and the large proportion of edge between woodlots and fields adds to their value. Mammals typical of these forests include the chipmunk, gray squirrel, and fox squirrel. Opossum, white-footed mouse, meadow jumping mouse, and striped skunk are common ubiquitous species often found in open woodlands. Deep-woods species which may have been more widely distributed in the past include least shrew and southern flying squirrel. Virginia white-tailed deer are infrequently found in the area, often feeding in fields and clearings adjacent to woodlots. Red fox and gray fox are also resident in woodlands but are likewise uncommon. A large number of small birds are characteristically associated with woodlands; these include the woodpeckers, eastern phoebe, eastern wood pewee, blue jay, Carolina chickadee, brown thrasher, cardinal, rufoud-sided towhee, and a variety of nesting and migrating warblers. The pileated woodpecker, rare now in the area, is a typical deep-woods species declining under the pressure of habitat loss. Forest raptors include Cooper's, broad-winged, and red-shouldered hawks, as well as the great horned and barn owls. Several reptiles, including the eastern fence lizard and eastern garter snake, are found in woodlands as well as other habitats; the five-lined skink and southeastern copperhead tend to prefer wooded areas.

Riparian and bottomland habitats are characterized by a group of species which tend to be most abundant in such situations. These include muskrat, belted kingfisher, tufted titmouse, nuthatches, Carolina wren, Blue-gray gnatcatcher, kinglets, and several of the vireos and warblers. Most amphibians are restricted to moist areas near water, and several of the snakes, including the eastern ribbon snake and rough green snake, are also found mainly near streams. Raccoons are almost always found near water.

The dense pine thickets afford habitat to many of the small bird and mammal species including a few, such as red crossbill, pine siskin, pine warbler, and pine vole, that are more characteristic of conifers than other vegetation types. However, the uniformity of physical structure of pine stands and their dense shade which reduces the growth of understory vegetation tends to make them generally less valuable habitats than the older hardwood stands.

Old fields, including young pine stands before the canopy closes, tend to have a distinct faunal assemblage which includes many of the widespread species of broad tolerance mentioned above. The white-footed mouse is especially common in old fields. In addition, the eastern cottontail, hispid cotton rat, and house mouse prefer the dense growth of tall weeds and grasses (MC-255). Birds commonly associated with old fields and clearings include sparrow hawk, marsh hawk, bobwhite, killdeer, common nighthawk, mockingbird, robin, eastern meadowlark, American goldfinch and most species of sparrows.

Status of Game Animal Populations

During brief field investigations conducted in November, 1976 by Radian Corporation biologists, deer tracks were seen near Lake Brandt. Hendrickson (HE-214) reported deer signs in the South Buffalo Creek drainage. Deer probably utilize the relatively continuous woods and thickets in the study area as routes of movement to and from the larger areas of woodlands. Although habitat for deer is greatly fragmented in Guilford County, the combination of woody and old-field herbaceous cover could probably support a much larger population than is now found there.

Gray and fox squirrels are generally hunted in wooded riparian habitats; good hunting is localized in these areas in Guilford County. Nests were commonly observed in the study area in November, 1976 by Radian biologists. Availability of food--primarily acorns--seems to be the major factor determining the year-to-year variations in size of the squirrel population, although its overall limits are set by the availability of woodland habitat (NO-115).

Waterfowl of various kinds utilize the lakes, streams, and ponds in Guilford County, primarily in winter and during migration. Canada geese are common winter migrants, and mallards are common winter residents. Other species observed regularly, but not commonly, include pintail, gadwall, blue-winged and green-winged teal. Only the wood duck is listed as a permanent resident (DA-227). Hunting for waterfowl is limited in Guilford County. Lake Brandt and possibly other lakes were hunted as recently as 1967 (VA-157).

Red fox, gray fox, and raccoon are popular quarries, hunted with dogs and/or from horseback. Extreme pressure resulted in population declines during the 1950's. Raccoon sign was found along Horsepen Creek by Radian biologists, corroborating Hendrickson's earlier observations (HE-214).

In addition to the above species, muskrat and opossum are trapped for fur. Muskrat is the most important furbearer in Guilford County. Muskrat sign or road kills were noted on or near Horsepen Creek by Hendrickson (HE-214). Muskrat abundance is probably controlled mainly by habitat availability. Adequate combinations of food, cover, and permanent, relatively deep water are found naturally only along the main streamcourses and their tributaries. Farm ponds were not examined in the field, but it is probable that they supply additional habitat. Muskrat are probably also found along the shoreline of Lake Brandt where cattails and other emergent vegetation offer a combination of food and cover.

Endangered Species

None of the mammals of Guilford County are considered to be endangered either by the State of North Carolina or by the U.S. Fish and Wildlife Service (US-305, NO-120). The peregrine falcon which may rarely be seen in migration is officially classed as endangered by both entities, as is the bald eagle. The latter species is listed by Dawley (DA-227) as a rare permanent resident in the county. This list was published, however, in 1954, and no recent confirmations are available. Bald eagles prefer wooded areas near water and do not tolerate human activity within a mile or two of an active nest. If any eagles still remain in Guilford County's fragmented landscape it is unlikely that they breed there. The red-cockaded woodpecker is also listed by Dawley as a permanent resident, although recent confirmation is not available. The sharp-shinned hawk, a species listed as threatened (CO-582), is reported to nest near Lake Brandt. The State of North Carolina considers the eastern diamondback rattlesnake an endangered species, although it is not on the national list. Although range maps indicate that this species' overall distribution includes Guilford County (CO-391), its presence there has not been confirmed. The North Carolina Wildlife Resources Commission considers the Dyar moth (Acrabasis fettella) rare in the state which is at the edge of its range. This moth is closely associated with shagbark hickory and may reside in the county.

The white-crowned sparrow, though not in danger as a species, is at the edge of its range in North Carolina. The state's only known wintering population is located in the Horsepen Creek drainage. A small number of wintering birds have been observed around farm buildings adjacent to the Greensboro-Winston Salem regional airport. They probably utilize the waste grain to some extent. Owing to its unfavorable location, it is unlikely that residential land development would interfere with this population in the near future although industrial use of the land is not precluded.

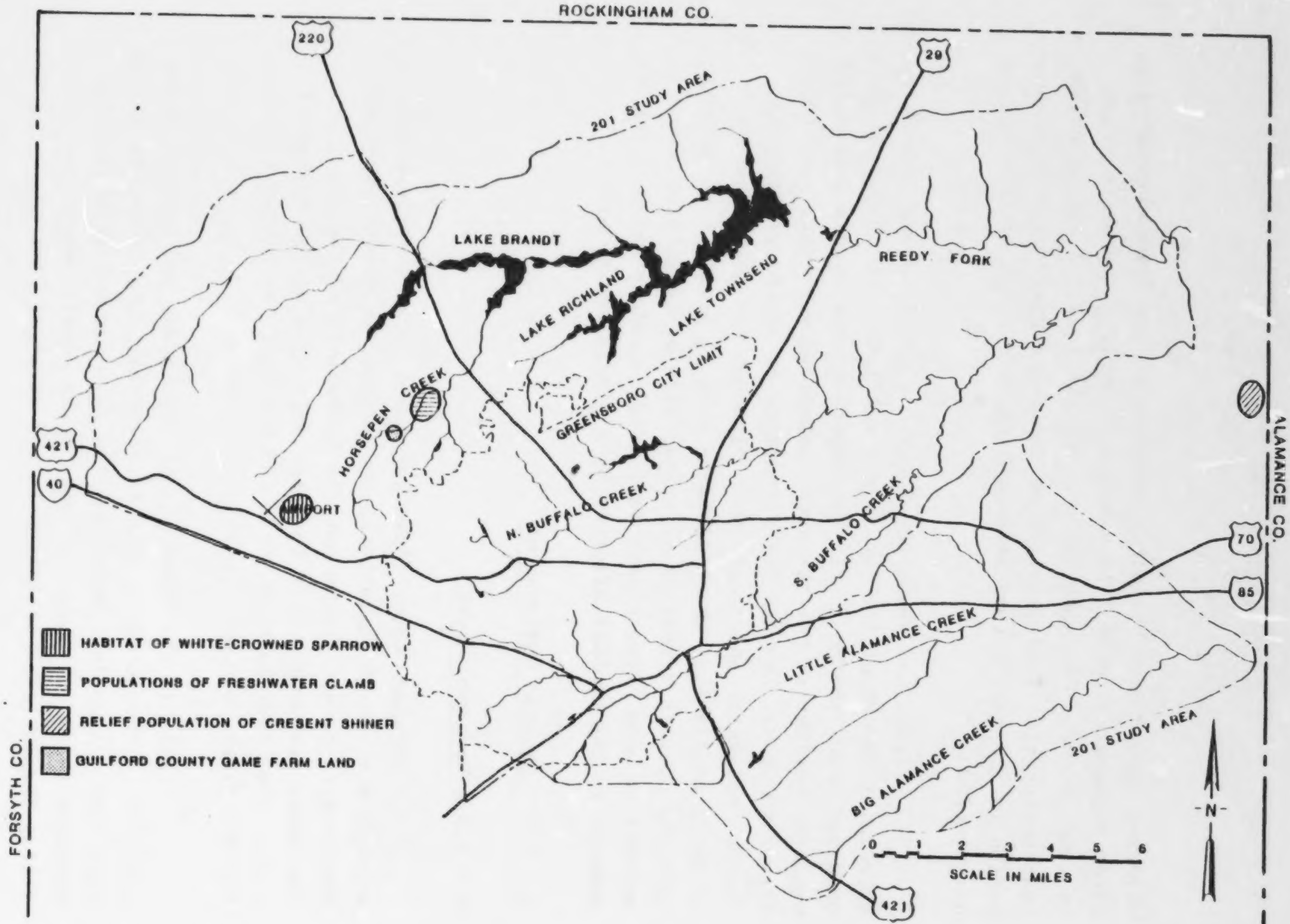
Figure 4-8 shows the locations of all areas considered especially important for the area's wildlife. It should be emphasized that the most critical aspect of the area's fragmented woodland habitat is not the areal extent of woodlots, but the degree to which they are interconnected by strips of standing timber, thickets, and fencerows. Although not mapped because of their complexity, these linkages make it possible to maintain the present diversity of animal life by permitting the animals to move between many individual woodlots which could not subsist in the habitat afforded by a single forest stand.

4.2.3.2 Aquatic Environment

4.2.3.2.1 Horsepen Creek

Horsepen Creek flows through a largely agricultural watershed in which residential development is occurring at an accelerated pace. Throughout the headwaters of the creek, the banks are unwooded or bordered only by a narrow fringe of trees; the lower portion, near the mouth of the stream at Lake Brandt, flows through a forested floodplain.

Flow in the creek is not regulated, and typical flows are low. Although the stream is perennial, low flows are little more than a trickle. Water quality data are not extensive for Horsepen Creek, but observations of the aquatic ecosystem in the stream suggest that pollution is not strongly limiting. The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ALAMANCE CO.
FORSYTH CO.
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70
85
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201 STUDY AREA
LAKE BRANDT
LAKE RICHLAND
LAKE TOWNSEND
REEDY FORK
GREENSBORO CITY LIMIT
HORSEPEN CREEK
AIRPORT
N. BUFFALO CREEK
S. BUFFALO CREEK
LITTLE ALAMANCE CREEK
BIG ALAMANCE CREEK
201 STUDY AREA
HABITAT OF WHITE-CROWNED SPARROW
POPULATIONS OF FRESHWATER CLAMS
RELIEF POPULATION OF CRESENT SHINER
GUILFORD COUNTY GAME FARM LAND
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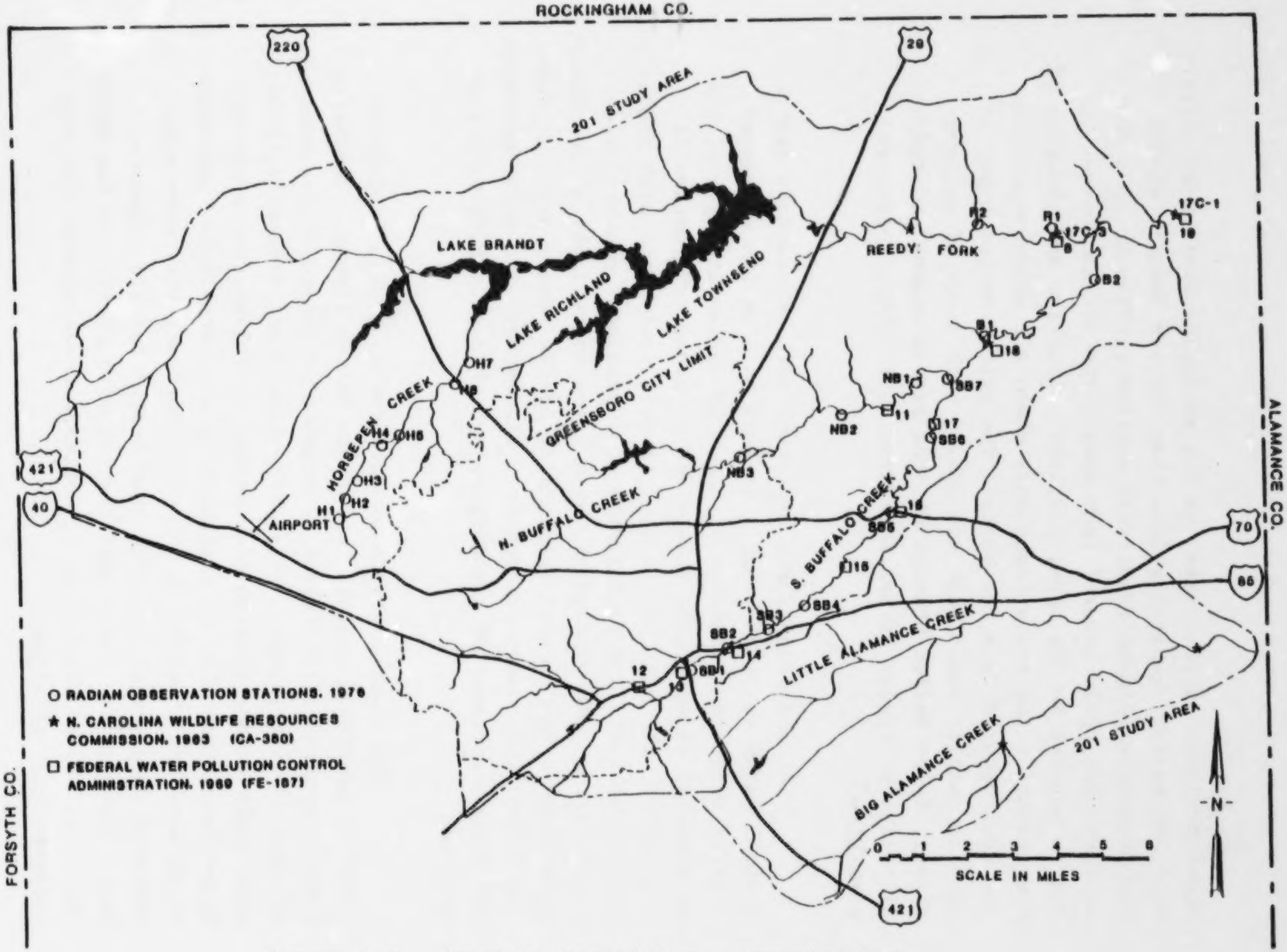
SCALE IN MILES

Figure 4-8. Biologically Sensitive Areas

upper portions of the creek, as far as Radian Station H5 (Figure 4-9) are narrow (generally less than sixteen feet in width) and alternate between relatively shallow riffles up to a foot in depth and pools several feet deep. The stream channel is cut to bedrock in the upper portions. Cracking and slumping of the channel sides are evident only where all woody vegetation has been cleared from the banks. The bottom in the upper portion is chiefly small rock and gravel with sands of various sizes. Below Radian Station H5, the stream widens and deepens. Silt-size particles become more prominent, which increases turbidity.

At the point where Horsepen Creek enters Lake Brandt, a small marsh swamp of roughly an acre in size has developed. A brief visit to this marsh was made by Radian biologists, but no detailed observations were made; no other information is available. The bulk of the area is relatively open with mannagrass, bullrush, and cattail the most prominent plants. Alder, black willow, and buttonbush, with a few individuals of red maple, form a dense band around the outside of the swampy area, decreasing in density toward the center. Bladderwort and water hyacinth are common in areas of standing water. Mosquito fish were also observed.

The aquatic organisms observed by Radian biologists point to generally healthy conditions in the stream. Caddisfly larvae, generally intolerant of organic pollution, were abundant at nearly all stations. Moderately intolerant dragonfly larvae were found at one station accompanied by filamentous green and blue-green algae that were growing on adjacent rocks. Although algae were not abundant on the creek bottoms, they were more commonly observed on Horsepen than on the Buffalo Creeks or Reedy Fork; it is likely that the relative clarity of the water and stability of the bottom of Horsepen Creek account for the larger number of algae.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LAKE BRANDT
LAKE RICHLAND
LAKE TOWNSEND
GREENSBORO CITY LIMIT
REEDY FORK
HORSEPEN CREEK
N. BUFFALO CREEK
S. BUFFALO CREEK
LITTLE ALAMANCE CREEK
BIG ALAMANCE CREEK
AIRPORT
H1
H2
H3
H4
H5
H6
H7
R1
R2
17C-1
17C-3
19
8
B2
B1
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NB1
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☐ FEDERAL WATER POLLUTION CONTROL ADMINISTRATION. 1969 (FE-187)
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Figure 4-9. Sampling Localities: Aquatic Biota

Both Hendrickson (HE-214) and Radian biologists noted evidence of a small population of freshwater clams at and about station H5. These have not been identified as to species.

Hendrickson visited Horsepen Creek in 1975 and reported on the vertebrate fauna he found there (HE-214). Fishes he observed included:

Crescent shiner
River chubsucker
Tesselated darter
Speckled killifish
Piedmont chub

The first of these is noteworthy in that it is known primarily from the Roanoke drainage and occurs in only one other locality in the Cape Fear drainage. The species is not, however, considered endangered. Amphibians observed by Hendrickson included the dusky salamander, green frog, and bullfrog. He also observed a northern water snake during his investigation.

4.2.3.2.2 Lake Brandt

At the present time, comparatively little information is available on the aquatic ecosystem of Lake Brandt. The information presented here was furnished by Scott Van Horn of the North Carolina Wildlife Resources Commission (VA-157).

Lake Brandt was built in 1921 and expanded to its present size of 2000 surface acres in 1960. The lake has a mean depth of 36 feet and stratifies in summer with the thermocline at about 13 feet. Temperatures measured in July, 1969 were 88°F at the surface and 65°-76°F below the thermocline. Dissolved oxygen was adequate in the surface layer (8 mg/ℓ) but greatly depleted below the thermocline (0-1.5 mg/ℓ).

The shallower portions of the lake, especially the mouth of Horsepen Creek and Reedy Fork as it enters the lake, become choked in summer with extensive beds of water lilies and pondweeds of various kinds. No information is available regarding algae found in the lake or the extent to which spring and/or fall turnover influences their abundance. Table 4-8 lists fish found in the lake. Fishing on the lake is popular, although permitted only from city-owned boats. Lack of forage species has been a problem in Lake Brandt, and threadfin shad were introduced in 1967 and 1969. Fish from these stocks winterkilled, but restocking in 1972 seemed to produce a surviving population. Because of low availability of forage fish, largemouth bass are small and slow-growing.

TABLE 4-8

FISHES OF LAKE BRANDT

Game Fish	
[1]Pumpkinseed	Lepomis gibbosus
[1]Bluegill	Lepomis macrochirus
Black crappie	Pomixis nigro-maculatus
[1]White crappie	Pomixis annularis
Yellow perch	Perca flavescens
Redbreast sunfish	Lepomis auritus
Warmouth	Chaenobryhus gulosus
Green sunfish	Chaenobryhus cyanellus
[3]Chain pickerel	Esox niger
[2]Largemouth bass	Micropterus salmoides
[3]White bass	Morone chrysops
Non-Game Fish	
[1,2]Yellow bullhead	Ictalurus natalis
Brown bullhead	Ictalurus nebulosus
Black bullhead	Ictalurus melas
Flat bullhead	Ictalurus platycephalus
[1,2]White catfish	Ictalurus catus
[1]Channel catfish	Ictalurus punctatus
[2]Carp	Cyprinus carpio
Goldfish	Carassius auratus
Golden shiner	Notemigonus chrysoleucas
[3]Threadfin shad	Dorosoma petenense
[3]Blueback herring	Alosa aestivalis

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[1] Major species by weight (Source: VA-157)

[2] Major species by number (Source: VA-157)

[3] Stocked but possibly not surviving over winter

CHAPTER 5

EFFECTS OF THE PROPOSED ACTION

5.0 EFFECTS OF THE PROPOSED ACTION

5.1 The Natural Environment

5.1.1 Air Quality

The standard "criteria" pollutants describing air quality impacts are total suspended particulates (TSP), sulfur dioxide, nitrogen dioxide, carbon monoxide, and hydrocarbons (photochemical oxidants). Odor is not a part of the federal air quality standards but is of concern to this project. The impact of this airborne pollutant is addressed in the next section.

Direct Impacts

Of the five criteria air pollutants, only TSP is of any significance to this project. Small amounts of the other pollutants will be emitted during construction, but their impact on existing air quality will be negligible. Fugitive dust emissions resulting from construction of the Horsepen Creek interceptor system will cause a short-term local increase in TSP levels.

Studies have shown that quantity of dust generated can be correlated with climate, soil type, and extent of construction activity (EN-071). In general, maximum emission rates expected are one ton of TSP per acre of construction activity per month. This represents a worst-case condition; actual TSP levels may be significantly less, depending on the factors listed above. The total acreage under construction at any one time will probably be small (1-5 acres). Consequently, adverse impacts related to TSP levels are expected to be minor.

Indirect Impacts

Secondary air quality impacts will occur due to growth-related aspects of the proposed action. The projected population increase in the study area after project completion will most likely cause increases in the criteria air pollutants. The proposed action favors a low density type of development with relatively low TSP levels when compared to high density development TSP levels. In any case, urban particulate emissions will replace rural/agricultural particulate emissions due to expected land use charges. Unfortunately, urban particulate emissions are probably more hazardous to health. Geographical population distribution is not expected to have a pronounced effect on area levels of the other criteria pollutants, so all alternatives proposed would have the same impact assuming population growth is constant.

The status designations required by the 1977 Clean Air Act Amendments listed Guilford County as better than the national standards for all criteria pollutants. For areas better than the national standards, increases in criteria pollutants due to growth are controlled by prevention of significant deterioration regulations. It is not anticipated that the proposed action will have any significant deleterious secondary air quality impacts.

5.1.2 Odor

In general, no adverse odor impacts are associated with construction and operation of the interceptor, force main, and pump station network as proposed. The present sanitary sewerage system in the Horsepen Creek area is oversized in the upper portion of the basin resulting in occasional septic odors at manholes and wet wells due to the slow moving wastewater stream.

This condition usually occurs during dry periods when low flow conditions are most pronounced. Additional odor problems associated with occasional surcharging of lift stations have been reported.

Odor problems associated with a slow-moving wastewater stream in the upper basin will not be completely eliminated by the proposed action. However, overall impacts of the proposed action should result in a net decrease in odor problems in the area due to elimination of the present system of lift stations which occasionally surcharge. Flushing of lines in the upper basin area as a method of reducing septic odors is probably not a sound approach. Water supplies in the area are limited, and low flow conditions inevitably coincide with peak water demand periods.

5.1.3 Noise

Direct Impacts

The principal noise impacts expected with the proposed action will occur during the construction phase. Heavy equipment operation for trenching, pipe laying, backfilling, etc., will create locally excessive noise levels. During construction of an interceptor, mild adverse reaction may be expected at a distance of up to about 700 feet due to trucks, cement mixers, etc., in the area. Adverse reactions may be expected at distances up to 2000 feet if rock-blasting or drilling is required. If an average pipe-laying rate of 3000 feet/month is assumed, noise impacts may be felt in a residential area for a period of two weeks to a month. Most of the interceptor routes for the proposed action are not contiguous with residential areas, so objections should be minimal.

Terrestrial wildlife in the area may exhibit an avoidance response due to noise during construction. Species which are particularly dependent on acoustical signals will be affected the most. Animals which leave the immediate vicinity of the construction can be expected to redistribute in normal fashion after the disturbance in the area is over.

Indirect Impacts

After the construction phase of the proposed action is completed, noise levels in the area may decrease slightly due to elimination of seven lift stations. This decrease will probably cause an imperceptible reduction in ambient noise levels. Long-term impacts of the Horsepen Creek interceptor system with respect to noise will result in an increase in ambient noise levels. This increase is due to urbanization of the area with attendant increases in traffic, construction, industrialization, and other noise-producing sources. The proposed action will minimize future noise impacts by favoring a lower density, septic tank type of residential development, as opposed to a high density, sewered type of residential development.

5.1.4 Soils

Most of the Horsepen Creek basin area is in the Cecil, Mecklenburg, Madison, and Enon soil series, all of which have phases that are classified as prime farmland soils. Underlying these soil associations is a relatively thick, impermeable layer of saprolitic material. In general, the soils in the area are poorly suited to septic tank usage. The upland soils on the basin margin and the soils throughout the lower basin are better suited than other soils in the area for septic tank use. Most of the farm and pasture land presently exists in the southwestern portion of the basin.

Direct Impacts

Construction of the proposed Horsepen Creek interceptor system will result in devegetation or disturbance of approximately 123 acres assuming a 75-foot right-of-way. Erosion of these areas may be a particular problem in the central (non-upland) part of the basin where the Enon-Mecklenburg soil association is common. This soil association is considered to have a pronounced erosion potential. Sediment control measures may be necessary during the construction phase when this soil type is encountered, particularly in areas of high slope or proximal to the creek and its tributaries.

Present conditions indicate that large amounts of colloidal sediment particles are being delivered to Horsepen Creek and Lake Brandt. Construction of an interceptor along the creek will likely result in an increase in the delivery of settleable solids. This could have a negative impact on the aquatic biota in Horsepen Creek. Sessile organisms may be particularly affected. Impacts associated with stream siltation and substrate modification due to increased sediment delivery during construction should be short-term with a return to baseline conditions following the construction phase.

Indirect Impacts

Urbanization of all the remaining developable land in the Horsepen Creek area is projected as a result of the proposed action. This includes the land presently in use for farm and pasture (approximately 18% of the total study area) as well as forested areas (approximately 38%). However, most of this land would be lost from potential productivity in any case. Its current economic value for suburban development is much greater than its agricultural value. This change in land use would occur under all the alternatives considered, including the "No Action" alternative.

Results of the STORM modeling efforts on Horsepen Creek (RA-R-667) water quality indicate that total suspended sediment loads will decrease due to land use changes during development. A 46% decrease is predicted for septic tank development. Likewise, a 46% increase in settleable soils is predicted. The primary impacts of these sediment loading changes will be discussed in detail in the hydrology section.

5.1.5 Hydrology

The Horsepen Creek interceptor system is expected to have a significant impact on the quality of water in Horsepen Creek and Lake Brandt. Direct impacts associated with construction should be minor if proper sediment control measures are used. However, indirect impacts associated with ultimate development in the watershed are more complicated to assess. Lake Brandt is currently a major water supply for the city of Greensboro. As such, protection of its water quality is the most important environmental concern of this project. Analysis of expected impacts of the proposed action relies primarily on water quality predictions generated by the STORM modeling efforts. These results will be discussed in the section on surface water.

5.1.5.1 Ground Water

Direct Impacts

Construction of the Horsepen Creek interceptor should not have an appreciable effect on ground-water supply or quality. Elimination of the existing system of force mains and lift stations should decrease surcharging and exfiltration in the area.

Current ground-water supplies are of adequate quality for individual users. The thick soils and saprolite are of low permeability which tends to protect ground-water quality.

Indirect Impacts

The ultimate development of the Horsepen Creek basin will be the most serious impact on ground-water quality. The proposed action implies a pattern of development that includes increased septic tank and sanitary sewer use in the basin. Present estimates predict a full development population of about 18,700 (a 130% increase). The Horsepen Creek interceptor system has the capacity to serve approximately 12,000. Assuming that good, up-to-date engineering practices are used to prevent exfiltration, an increase in sewered population should not harm ground water quality. Elimination of some existing septic tanks by connection to the new lines may initially reduce present levels of ground water pollution. The impact of septic tank proliferation in the area on ground-water quality will be a function of the degree of stringence and enforcement of local ordinances concerning their use.

The urbanization associated with the proposed project will increase ground-water withdrawals by residences which are not included in Greensboro water supply system. The amount of withdrawal is not expected to deplete the aquifer, but the increase in impervious area may reduce recharge rates slightly. Primary recharge areas for the aquifer system are the interfluves or upland areas. Approximately 10-15 percent of annual precipitation infiltrates into subsurface to become groundwater recharge.

The greatest threat to ground-water quality may be the potential for high density septic tank development, particularly in upland recharge areas. Fecal coliform levels are already high in Horsepen Creek, and septic tank contamination of the ground water could elevate these levels to the point of becoming a health hazard. Mitigating measures to prevent this occurrence will likely be through land use controls and ordinances mentioned earlier, especially the newly enacted Guilford County septic tank ordinance. Specific recommendations for minimizing impacts on ground water and Lake Brandt water quality will be discussed in the next chapter.

5.1.5.2 Surface Water

5.1.5.2.1 Effects on Horsepen Creek Water Quality

Direct Impacts

Direct impacts on surface water during construction of the interceptor system are primarily related to increases in sediment loading to Horsepen Creek and ultimately Lake Brandt. The expected increase in settleable solids discussed in the soils section should be of no identified consequence to surface water quality. Colloidal particles in sediment runoff from erosion are often nutrient enriched, and a short-term increase in nutrient levels in the creek may result.

Indirect Impacts

The urbanization which is expected after completion of the proposed project will have serious consequences on surface water characteristics in Horsepen Creek and Lake Brandt. Predictions for changes in pollutant loads for sewered and septic tank development scenarios using the STORM water quality model will be discussed in the following section.* However, before examining the model results a brief discussion of the sources of non-point pollution is appropriate.

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*A detailed water quality monitoring and modeling study has been completed for this EIS (RA-R-667).

When examining non-point pollution it is necessary to differentiate between dry weather periods and wet weather periods. Sources of non-point dry weather pollution include ground water discharge, septic field drainage, and sanitary sewer leakage. These can be classified as lateral inflow sources. In contrast, wet weather non-point pollution is primarily due to stormwater runoff, or overland flow. Generally speaking, stormwater runoff has a more deleterious effect on surface water quality than lateral inflow pollutant sources.

The following is a list of sources of pollution present in urban runoff:

1. Street "materials" including animal wastes, garbage, grit, oil, road salt, cinders, and residual particulates resulting from auto, tire, and brake use.

2. Surface non-street "materials" including animal wastes, garbage, fertilizers, chemicals, pesticides, household, and commercial refuse awaiting collection.

3. Silt from urban construction activities.

4. Leakage and overflow from defective and overcharged sanitary and combined sewers.

5. Deposition of airborne particulates.

6. Materials discharged in commercial and industrial plant floor drains.

7. Unrecorded and undetected discharges from diverse point sources of liquid wastes and leachates, including improper connections to storm drains.

STORM Model Results

The "STORM" model uses information on precipitation rates, pollutant accumulation rates, and hydrologic characteristics of the watershed under investigation in order to simulate stream-flow and water quality. The model was calibrated to Horsepen Creek conditions using available historical data from the U.S. Geological Survey (U.S.G.S.) and data collected during a monitoring program conducted by Radian Corporation. The methodologies used in calibrating and using the STORM model as a predictive tool are discussed in detail in the section entitled "Investigation of Water Quality Impacts Related to Development of the Horsepen Creek Basin" found in RA-R-667.

Two basic scenarios were evaluated using the STORM model: 1) development with sanitary sewers only, and 2) development with septic tanks only. The existing annual pollutant loads to Lake Brandt from Horsepen Creek are presented in Table 5-1. The STORM predictions of future annual loads from Horsepen Creek for development with a sanitary sewer system and with septic tanks are presented in Table 5-2 and Table 5-3, respectively. The year 2000 population projections of 18,700 were used for both scenarios. The ultimate increase in population associated with the future sewer service alternatives will significantly increase the potential adverse impacts of these alternatives beyond the discussion presented here for the 20 year design period.

TABLE 5-1
AGGREGATED EXISTING ANNUAL LOADS TO LAKE BRANDT FROM HORSEPEN CREEK

Parameter	Annual Load (tons/year)
Sediment	13041
Total Nitrogen	63.5
Orthophosphate	0.47

TABLE 5-2
FUTURE ANNUAL LOADS FROM THE HORSEPEN CREEK BASIN DEVELOPED WITH A SANITARY SEWER SYSTEM

Parameter	Annual Load (tons/year)	Percent Change from Existing
Suspended Solids	11553	-13.0
Settleable Solids	19.8	+78
B.O.D.	88.3	+ 1.0
Total Nitrogen	48.3	-31
Orthophosphate	0.702	+49
Fecal Coliform	1,396,330 x 10^9 MPN	+65

TABLE 5-3
FUTURE ANNUAL LOADS FROM THE HORSEPEN CREEK BASIN DEVELOPED WITH SEPTIC TANKS

Parameter	Annual Load (tons/year)	Percent Change from Existing
Suspended Solids	7045	-46
Settleable Solids	24.6	+46
B.O.D.	106	+20
Total Nitrogen	43.1	-32
Orthophosphate	0.8	+70
Fecal Coliform	1,695,325 x 10^9 MPN	+100

The model predictions indicate that water quality of Horsepen Creek will be a partial function of the type of urbanization that takes place. It is important to stress that the two scenarios represent extremes; the proposed action will encourage a type of development intermediate between these extremes. Nevertheless, the model results should provide a reasonable, qualitative prediction of water quality changes expected.

Comparison of the results for each scenario with existing conditions indicates that suspended solids and nitrogen loadings will decrease. In particular, a septic tank type of development would result in a significant reduction (46% of existing) in suspended solids levels. Conversion of almost all agricultural land and much of the forested area in the basin to residential use, and resultant decreases in erosion rates accounts for this change.

Phosphorous, biological oxygen demand (BOD), and fecal coliform levels are expected to increase with greater increases of these pollutants expected for septic tank development. Horsepen Creek currently has high water quality with corresponding low BOD levels and high DO levels. Increasing the BOD and phosphorous loading to Horsepen Creek will lower dissolved oxygen levels and encourage eutrophication, both considered negative impacts. Some aquatic organisms may suffer a reduction in available habitat area as a result of these changes.

5.1.5.2.2 Effects on Horsepen Creek Flow

Urbanization of the Horsepen Creek watershed will cause changes in streamflow characteristics. Increases in impervious areas result in lower base flows, shortened lag times during storms, and higher flood rates. All of these effects are due to decreased infiltration during storm events.

The STORM model (RA-R-667) results predict an increase in road mileage in the basin from the present 55 miles to 128 miles with sanitary sewer development or 155 miles with septic tank development. Base flow to Horsepen Creek is estimated to decrease by 17 percent after urbanization with sanitary sewerage. Base flow rates are presently low, and further reduction may impair the aquatic habitat.

Shortened lag times and higher peak flood rates occur as a result of urbanization. Increased flood rates may cause greater channel erosion and alteration of streambed characteristics. The STORM model does not consider stream channel erosion, so predicted decreases in sediment loading may be high. The actual amount of erosion will depend on streambed composition and the severity of storm events. A by-product of shorter lag times and increased flows is enlargement of floodplain areas. Expansion of the Horsepen Creek floodplain may necessitate restrictions on residential development in these areas.

5.1.5.2.3 Effects on Lake Brandt Water Quality

Water quality results indicate that Lake Brandt has fair to good water quality at present. Turbidity levels due to suspended solids loading are high, but have been decreasing gradually (GR-280). Secchi disk depth, a measure of light penetration in the water column, is approximately one foot. Biological productivity is limited by light penetration; consequently the lake is classified as only moderately eutrophic.

Urbanization of the basin will increase the concentrations of heavy metals in storm water runoff. Analyses to date indicate lead (Pb) levels from 5 μg/ℓ to 60 μg/ℓ are present in Lake Brandt. Data from the water quality monitoring programs indicate that a 20 percent increase in annual lead (Pb) yield from Horsepen Creek will result from development with sanitary sewers

(RA-R-667). The proposed action can be expected to increase lead levels similarly due to the increased development acreage necessary for septic tank residences. Primary drinking water standards give a maximum "safe" level of 50 μg/ℓ (lead). For this reason, any increase in lead levels over present levels could result in unsafe lead levels in parts of Lake Brandt. Annual lead loads may not be as significant as lead concentration "peaks" after storm events when road surfaces are flushed.

The drinking water standard for maximum arsenic concentration is 50 μg/ℓ. Water quality monitoring results indicate a possible trend of increasing concentrations in both arms of Lake Brandt from the headwaters to the dam. Even though inflow concentrations were on the order of 1 μg/ℓ, lake concentrations ranged from 10.8 μg/ℓ in the Reedy Fork arm to 16.8 μg/ℓ at the dam. It is possible that arsenic-containing sediments are being recycled under acidic and/or chemically reducing conditions. Sources of arsenic in the Lake Brandt watershed are unknown at this time. As forested areas in the Horsepen Creek basin are developed, waters draining these areas can be expected to change in pH. Wide pH fluctuations have been observed in Lake Brandt in recent years. Since Lake Brandt water has a low buffering capacity, it is particularly susceptible to pH changes from inflowing water. A permanent or seasonal change in pH of Horsepen Creek water could alter the equilibrium between trace elements in solution and in bottom sediments. This in turn could increase arsenic concentrations to unsafe levels in Lake Brandt.

Water treatment at the City of Greensboro filter plants consists of alum and lime addition, followed by filtration, sedimentation, and chlorination. Present detection limits at these plants for heavy metals are approximatley 10 μg/ℓ, but no no heavy metals concentrations above 10 μg/ℓ have been noted to date.

Nutrient levels in Lake Brandt are presently 5 to 10 times greater than levels considered limiting to biological growth. Typical values considered limiting for algal growth are 0.025-0.1 μg/ℓ total inorganic-N, and 0.001-0.009 μg/ℓ total inorganic-P. Sawyer's pioneering work in Wisconsin (1947) indicated the potential for nuisance growth of algae if early spring concentrations in a lake exceeded 0.3 μg/ℓ inorganic-N and 0.01 μg/ℓ soluble-P (MA-743). Typical Lake Brandt concentrations have been in the vicinity of 1.0 μg/ℓ inorganic-N and 0.05 μg/ℓ ortho-P (the major inorganic P-form). Despite Lake Brandt's somewhat nutrient-rich state, neither stands of aquatic macrophytes nor nuisance algal blooms have developed. The probable critical factor in this case is the extremely turbid nature of the water. Photosynthesis is probably limited to the upper 2½ feet (the photic zone depth) of the water column.

The STORM model (RA-R-667) results indicate that nitrogen and suspended solids loadings will decrease, and phosphorus loadings will increase as a result of the proposed action. Studies concerning nutrient concentration and the trophic state of lakes (SC-A-468) indicate that phosphorus is the most important macronutrient for biological growth, and changes in the N:P ratio can result in changes in species dominance in lake phytoplankton communities. Increasing phosphorus concentrations coupled with decreasing nitrogen concentrations will lower the N:P ratio accordingly. This change may promote the growth of nitrogen-fixing blue-green algae such as *Anabena*, an alga responsible for nuisance "blooms". The lower turbidity associated with decreased non-settleable solids loads to Lake Brandt will also tend to promote the occurrence of niusance algal blooms. Thus Lake Brandt will probably become more eutrophic, with the proposed action accelerating this process somewhat. Water quality problems such as offensive taste and odor associated with decomposition of algal blooms may be expected to increase. Unit processes for removing taste and odor are not present at the Greensboro water treatment plants.

5.1.6 Biological Components

The environmental effects of the proposed action on terrestrial and aquatic biota in the Horsepen Creek area must be evaluated with regard to the existing conditions of these communities. Short-term direct effects will stem from construction along pipeline routes. Indirect effects will occur as a result of urbanization in newly sewered areas. It is assumed, however, that this growth would occur with or without the proposed action.

5.1.6.1 Land

Direct Effects

The proposed construction of a 76,000 foot interceptor system in the Horsepen Creek basin will disturb about 131 acres (assuming a 75-foot right-of-way). The loss of riparian woodlands along this route will be the main impact of the proposed action. Low growing grasses, herbs, and shrubs will revegetate the streambank after construction is complete.

Wildlife which presently utilize the riparian habitat along the proposed interceptor routes will temporarily withdraw from the noise and general human disturbance which accompany construction. Nesting sites or activities of some riparian birds and mammals will be destroyed or interrupted by construction, especially if construction takes place during the spring breeding season. A few individuals, such as leopard frogs, ribbon snakes or golden mice, will be killed as a direct result of construction.

Removal of these animals should not have any lasting effect on area populations. Because construction will proceed in a linear fashion down the creek, only a relatively small area will be disturbed at any given time. Some of the species which leave these areas because of construction disturbance will return after completion of the sewer line and revegetation of the disturbed area. Since the trees will not be allowed to re-establish themselves over the right-of-way, only the grassland animal species will repopulate the area. The forest species will be permanently displaced.

Indirect Effects

The indirect environmental effects of the proposed action on terrestrial flora and fauna will stem from urbanization in newly sewered, previously rural areas. Fragmentation of existing wildlife habitats will increase. Native vegetation will be replaced with urban species and wildlife will withdraw from the Horsepen Creek area due to increased human disturbance and loss of suitable habitat.

5.1.6.2 Water

Direct Effects

Siltation of Horsepen Creek due to erosion from construction areas is the primary impact anticipated from the proposed action. Colloidal solids will be transported downstream to Lake Brandt. Settleable solids may remain in the creek, altering the substrate somewhat until a storm event moves these particles into the lake. Benthic and other predominantly sessile organisms may be adversely affected by the increased suspended solids. The direct effects of construction are expected to be temporary and of no significance to existing aquatic populations.

Indirect Effects

Urbanization in the Horsepen Creek basin is expected to decrease base flows and increase pollutant loads to Horsepen Creek. Significant reduction in base flow rates may threaten the perennial nature of this stream causing fragmentation and loss of existing aquatic habitat. Small fish populations may become impounded if this occurs. Urban runoff and increased septic tank use in the basin are expected to increase BOD levels and decrease dissolved oxygen levels. In general, deterioration of the high quality aquatic habitat now present is expected. The degree of deterioration will be determined by specific developmental pressures and land use measures enacted to preserve Horsepen Creek itself.

Increased lead concentrations due to urban runoff may threaten fish populations in Horsepen Creek and Lake Brandt. Fish populations may be impaired if lead (Pb) concentrations exceed 30 μg/ℓ (NA-199). Concentrations higher than this have been observed in Lake Brandt near the dam and the Horsepen Creek arm of the lake. A persistent increase in lead levels over present may result in a reduction in species diversity. In general, urbanization of the Horsepen Creek area will favor pollution-tolerant species and restrict the habitat of less tolerant species.

5.1.6.3 Sensitive Areas

No rare/endangered terrestrial plant, animal, or aquatic species or habitats critical for such species are currently known to occur along the proposed pipeline route. Most of the areas have been previously disturbed by man's agricultural or residential use. Some woodland acreage will be destroyed, but other similar habitat areas will remain. The small freshwater marsh at the confluence of Horsepen Creek and Lake Brandt should not be significantly affected by the project.

5.2 The Man-Made Environment

5.2.1 Land Use

The proposed action presents an interesting situation from a land use perspective. Constant throughout this analysis has been an assumption that 18,700 people will live in the Horsepen Creek basin in the year 2000. That population represents a growth of 10,620 people from the 1975 population of 8,080. The purpose of this section is to project the effect the proposed action will have on the land use pattern which will evolve in serving those 10,620 people who will establish residences in that basin.

If public sewage will not be available for future residential developments, septic tanks or other private systems will have to be used. However, the proposed action will physically accommodate approximately 12,000 people. There is no reason to believe that the full capacity of that interceptor will not be used by the year 2000. If that is true, approximately 4,000 (12,000 - 8,000) of the 10,620 projected to move into the basin will be in the sewered subdivisions. Assuming 8 people per acre for sewered areas in the Greensboro vicinity (derived from Table II-31 in EN-R-618) an additional 500 acres will be developed with sewers by the year 2000.

The remaining 6,620 people will have to be served by private systems such as septic tanks. Guilford County requires a lot size of approximately 1 acre for a septic tank. It is assumed that private systems will only be used by single-family units (3.0 people per household). Therefore, 2206 acres of residential development with septic tank will occur by the year 2000 under the proposed action.

Additional residential development in the Horsepen Creek basin will amount to approximately 2700 acres (2200 + 500) by the year 2000. It has been projected that under any sewage plan 210 acres of commercial land and 150 acres of industrial land will develop (EN-R-618). Thus, a total of 3050 acres will be developed through the year 2000 under the proposed action.

The pattern of development should follow the trends already established. The commercial and industrial developments should occur primarily in the southwestern portion of the basin near the airport and along Highway 421. Further subdivisions with sewers will probably occur adjacent to the already sewered areas and those areas now on septic tanks to be sewered under the proposed action. This is so the costs of providing that service will be minimized. This would include much of the area close to New Garden Road in the central portion of the basin and along the eastern boundary of the basin. Those developments utilizing septic tanks will probably be in the northwestern portion of the basin. Land costs should be somewhat lower further from the city. This will be important when the cost of a 1-acre lot is taken into consideration.

The land use pattern which should result in the Horsepen Creek basin will be costly to accommodate from a public services perspective. It costs more to provide essential public services (transportation, utilities, schools, etc.) for a low density pattern than it does for a high density pattern (RE-118). From that perspective the proposed action has an adverse effect.

The 3,050 acres projected to change to urban use through the year 2000 are below the total 3,107 acres of area available for unrestricted future growth (RA-R-667). While the calculations used in these analyses are crude, it does appear that the proposed action will serve the projected population of the basin without encroachment upon environmentally sensitive areas. However, the margin for error is slight. The planning officials of Greensboro and Guilford Counties will have to prudently exercise the growth control measures they have at their disposals to insure the protection of environmentally sensitive areas.

CHAPTER 6

MITIGATING MEASURES

The 3,050 acres projected to change to urban use through the year 2000 are below the total 3,107 acres of area available for unrestricted future growth (RA-R-667). While the calculations used in these analyses are crude, it does appear that the proposed action will serve the projected population of the basin without encroachment upon environmentally sensitive areas. However, the margin for error is slight. The planning officials of Greensboro and Guilford Counties will have to prudently exercise the growth control measures they have at their disposals to insure the protection of environmentally sensitive areas.

CHAPTER 6

MITIGATING MEASURES

6.0 MITIGATING MEASURES

Mitigating measures for all areas of the environment that may be affected by this project are not discussed in this report. Only water quality and land use are discussed here, as impacts associated with these two areas will probably be the most significant to the Horsepen Creek watershed. Many of the mitigating measures discussed in Chapter 6 of the Greensboro EIS (EN-R-618) are also pertinent to impact mitigation for proposed activities in the Horsepen Creek basin; the interested reader is referred to this companion document for additional mitigating measures not addressed in this section.

6.1 Water Quality

The results of the discussion on effects of the proposed action indicate that degradation of the Greensboro water supply in Lake Brandt is the most serious adverse impact associated with this project. Direct impacts related to construction of the interceptor itself are minor if the erosion and sedimentation control ordinance is adhered to. The major adverse impacts on water quality are secondary effects associated with urbanization of the Horsepen Creek basin. Mitigating measures to reduce these impacts will be a function of growth management approaches to development in the Horsepen Creek basin which are adopted and administered, largely at the local level.

A comprehensive plan for growth management in the area will be the most effective method of preserving water quality in Lake Brandt. One explicit goal of this process must be minimizing water quality impacts as development proceeds in the Horsepen Creek area. The remainder of this section addresses basic features that should be implemented at the local governmental levels as a part of this urban watershed development planning and protection program.

A comprehensive water quality planning program should be instituted in the Lake Brandt watershed area. Section 208 of the Clean Water Act was intended to provide for the creation of such comprehensive water pollution control planning and management programs. These comprehensive programs address all significant water pollution problems in an area and develop pollution control strategies to deal with these problems. The EPA program provides for two options for plan preparation responsibility: local agencies representing each designated 208 Planning Area or a state agency in the remaining undesignated areas. Greensboro is not currently a designated local area. The preparation of a 208 plan in the Greensboro area would provide for a detailed analysis of local water quality problems and potential management programs. The North Carolina Department of Natural Resources and Community Development is currently preparing the statewide 208. Because of the importance of water quality planning in the Horsepen Creek basin, DNRCD intends to shift priorities to address the area in early 1979 (see appendix).

A storm water system encouraging storm water retention and infiltration would minimize the predicted impacts of storm water runoff on water quality. Ulitizing natural drainage patterns where possible, as opposed to a concrete-lined drainage system, is one method of accomplishing this objective. Natural drainage slows storm water runoff allowing more time for infiltration, longer lag times to peak flows, and lower peak flow rates. As a result, pollutant loads and erosion due to storm water flows are reduced.

A water quality monitoring program for Horsepen Creek and Lake Brandt should be implemented. Degradation of water quality due to urbanization has already been observed in other watersheds in the Greensboro area. Collection of good water quality data is necessary in order to formulate sound management decisions and pinpoint problem areas before they become critical.

Development in the freshwater marsh at the confluence of Horsepen Creek and Lake Brandt should also be specifically restricted. Marsh ecosystems act as natural waste treatment systems which require no maintenance.

Specific legal measures should be adopted to insure that future tie-ins to the Horsepen Creek interceptor do not exceed its design capacity. Enforcement of such a measure will be critical to maintenance of water quality in Horsepen Creek and Lake Brandt. If the capacity of the system is exceeded, overflows of sanitary sewage would jeopardize public health as well as water quality.

Finally, strict enforcement of the Guilford County septic tank ordinance will be vital to preservation of Horsepen Creek and Lake Brandt water quality. This ordinance will be instrumental in controlling the proliferation of septic tank residences in the area. Proper design and location of septic tank systems, as well as control of the density of septic tanks in a given area, will minimize deleterious impacts on water quality as a result of this type of development.

Many of these measures are already in use or under consideration by Guilford County. Protection of water quality in the Horsepen Creek basin is, in large part, the responsibility of local officiating bodies and citizenry. Whether the proposed action results in degradation of Greensboro's water supply will depend on the responsiveness of these groups at the local level to the need for controlled growth management.

6.2 Land Use

To insure that environmentally sensitive areas are not encroached upon by residential developments in the Horsepen Creek basin and that the land resource is used efficiently, Greensboro and Guilford County officials must plan for a particular growth scenario and implement controls to insure that development follows the plan. The Master Plan currently under consideration is a step in that direction. It is important, however, that the potential water quality problems associated with urban development are a major consideration in the development of this plan.

The subdivision ordinance of Guilford County has considerable authority to control the pattern of growth. Subdivisions must have acceptable sewage systems, either private or public. Those which will be private must meet the standards of the County Health Department, thereby protecting the water quality of Lake Brandt. Development in flood-prone areas is prohibited by this subdivision ordinance. This should be sufficient to restrict development immediately adjacent to Horsepen Creek.

The zoning ordinance is one of the strongest tools available for implementing land use policy through the municipality's inherent power to exercise reasonable control over property and persons under its jurisdiction. Zoning ordinances can regulate both the type and density of land use. To be most effective in the use of this power, the zoning ordinance should be based upon a master plan designed to achieve community land use goals and objectives. A major goal in the Lake Brandt watershed should be the protection of Greensboro's drinking water supply.

The stated policies of the Guilford County Board of County Commissioners show that county officials recognize the need for land use planning to protect a fragile environment. The "Open Space Program" of January 1977 explicitly stated that the natural and cultural environment must be protected during the course of residential, commercial, and industrial development. That same concern for balancing development interests with environmental considerations is present in the "Land Use Goals and Policies" statement of Guilford County. It is hoped that these goals and concerns will lead to the implementation of a comprehensive program for the protection of water quality.

The acquisition of land by the local governments is one means of conserving sensitive areas, limiting urban runoff, and providing recreational opportunities. Some of the means available to acquire such lands include:

1. Simple acquisition of land for recreation or conservation. The acquisition of land can be accomplished through purchase and lease-back arrangements with an owner. Gifts of land are also possible from citizens, groups, and corporations to municipalities, conservancies, and other organizations.

2. Easements - the purchase of conservation easements can be used to limit development in critical areas, woodlands, wetlands, water supply recharge areas, floodplains, and open spaces.

3. Multiple use of sewer rights-of-way - where possible, multipurpose uses of interceptor rights-of-way should be encouraged. These uses include bike paths, hiking trails, and nature trails.

Many of the measures required to promote orderly development of the Horsepen Creek area and preserve the water quality of Lake Brandt already exist. Perhaps the one possibility which would upset this balance would be subdivisions with sewage treatment via lift stations to public or private package treatment plants discharging to adjacent streams. High density residential development could be accommodated in that manner. Lake Brandt's water quality might be threatened by a proliferation of these developments. It may be necessary to prohibit that type of private facility.

An extensive thoroughfare plan not providing for high density population would be another way to guard against that contingency. The thoroughfare plan should be coordinated with the growth management plan now under consideration.

6.3 Cultural Resources

The major class of cultural resources which may be jeopardized by the proposed action would be archaeological artifacts. Since the exact routes have not yet been determined, a reconnaissance would be of limited value. Potentially affected areas will be surveyed to determine the presence of possible archaeological resources. This survey will be accomplished during the Step 2 process and the survey plan, and results will be subject to approval by the North Carolina State Historical Preservation Officer and State Archaeologist.

CHAPTER 7

PUBLIC PARTICIPATION

7.0 PUBLIC PARTICIPATION

At the initiation of the EIS process, a public participation program was developed to insure public involvement in all phases of the EIS. On November 10, 1976, a public meeting was held to solicit public input on major issues which should be covered in the EIS and to ask for nominations for an EIS Advisory Committee. Soon after this meeting, the Advisory Committee was organized. This committee included the following representatives from governmental agencies, private organizations, and groups interested in the project:

Mr. Ray Shaw	City of Greensboro
Mr. Charles Mortimore	
Mr. Gaston Faison	County Commissioners
Mr. Brent A. Hall	
Mr. Tom Routh	Chamber of Commerce
Mr. Thomas E. Hubert	
Mr. Carl Loop	PTCOG
Mr. Lindsey Cox	
Mr. Fred Clapp	Board of Realtors
Mr. Richard Rough	
Mr. David Dansby	Greensboro Citizens Association
Mr. Herman Fox	
Dr. Burley Webb	North Carolina A & T University
Mr. Gerard Gray	
Mr. John Jezorek	Environmental Action Coalition
Dr. Ernest Lumsden	
Ms. Jean Lumsden	League of Women Voters
Ms. Ellen Olson	
Mr. Francis Steltzer	Rural/Suburban Community
Mr. Bob Cole	
Ms. Pat Walker	The Sierra Club

Ms. Betty Cone Dr. Paul Lutz	Guilford County Advisory Board for Environmental Quality
Mr. R.L. Thomas Mr. William Ashworth	Concerned Citizens of McLeansville
Mr. S.T. Hoffman Ms. Judy Huckabee	McLeansville Community Council
Mr. E.R. Lashley	Piedmont Council of Engineering and Technical Societies
Mr. J.B. Erwin Mr. B.J. Battle	NAACP
Ms. Ann Lineweaver Mr. Herbert Reese	GATEWAYS
Mr. Jim Jobe Mr. Bill Anderson	McLeansville Merchants Association
Mr. Tom Veal	Greensboro Jaycees
Mr. Tom Duckwall Mr. R.H. Souther	Audubon Society
Mr. W.S. Griswold	Homebuilders Association

Input from the EIS Advisory Committees included the following:

- identify local planning objectives
- identify study area issues
- review existing conditions inventories
- assist in the development of alternatives
- assist in comparison and evaluation of alternatives

The Modified No Action alternative discussed in this EIS was developed by the EIS Advisory Committee.

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APPENDIX

North Carolina Department of Natural Resources & Community Development
James B. Hunt, Jr., Governor
Howard N. Lee, Secretary

June 28, 1978

Mr. John White
Region IV Director
U. S. Environmental Protection Agency
345 Courtland Street
Atlanta, Georgia 30308

Dear Mr. White:

This letter acknowledges your proposed actions with respect to approval of alternatives outlined in the Greensboro (Horsepen Creek) Environmental Impact Statement. I could have enthusiastically supported a decision to select the alternative providing service to the area for the 20-year planning period as set forth in the federal guidelines. The alternative providing for limited development that you have decided to approve is not, in our opinion, the best decision in this case. However, in order to allow this needed project to proceed -- while I do object, I will not protest.

As outlined at the meeting on May 19, 1978, you stated the need for a Wastewater Management Plan for the Horsepen Creek drainage basin. We feel that the City and County are, in fact, planning to meet these needs, but we believe that additional capability and expertise will be needed to prepare such a plan. We, therefore, intend to shift priorities within our 208 planning efforts to address that area in early 1979, and will urge City and County cooperation with our 208 Planning Unit. Without such teamwork, it will be impossible to prepare a Wastewater Management Plan in which the local governmental units can take pride and can use as the planning tool it is meant to become.

With kindest regards and best wishes, I am

Respectfully yours,

Howard N. Lee

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